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AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

VOLUME XIII NOVEMBER 3, 1924 NUMBER 18

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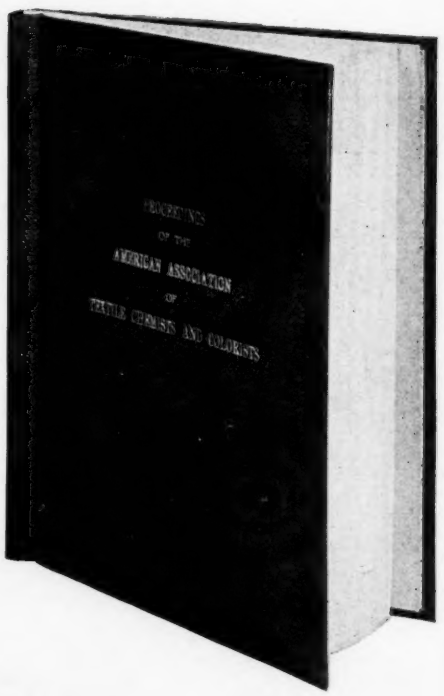

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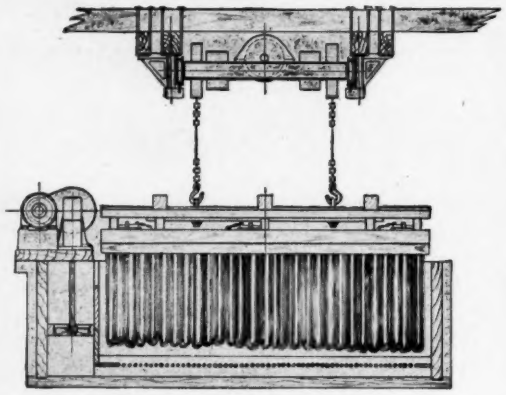

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VOLUME XIII NEW YORK, NOVEMBER 3, 1924 NUMBER 18

Mercerizing—Modern Research and Its Results

Part II

Investigations on Yarns and Fabrics More Complicated and Not at All Complete—Mercerization Not a Chemical Action but Purely a Physical Effect—Characteristic Properties Are Due to Swollen Cotton and Greater Surface—Hydrate Cellulose an Unsatisfactory Name

By CHARLES F. GOLDTHWAIT

[EDITOR'S NOTE.—*This is the fourth article in the series on "Mercerizing" by Charles F. Goldthwait which began in the September 22 issue of the* AMERICAN DYESTUFF REPORTER.]

WHEN we come to the mercerization of yarns and pieces the valuable effects all depend upon tension, and the tension necessary for proper mercerization depends for its effects on the plastic properties of cotton soaked in caustic. The natural convolutions in cotton fibers were originally caused by strains set up during natural drying and are due to the minute structure of the individual fiber wall. The shrinking of cotton and the untwisting of the natural convolutions during mercerizing are due to changes in configuration or to strains within the fiber, which are allowed to act when the cotton is softened [11]. The new permanent shape of the fibers caused by tension is really due to plasticity, the property of taking a permanent set, as contrasted to elasticity, the property of recovering from a deforming stress.

Experiments on yarn mercerizing are complicated by innumerable variables, and while it is possible to see that one yarn has come out better than another, it is almost impossible to positively trace the effect of any one condition. In the first place there has been no accurate way of observing and measuring slight differences in the result. Then again, it takes so many tests to arrive at general rules that nobody has time to make them all. For instance, good work may be attributed to special yarn construction when it is really due more to machine control. The point could not be positively proved without running large amounts of uniformly spun yarn under varying mercerizing conditions, and then running a series of special spinnings on a given stock with constant machine conditions, and finally going over a good share of the same ground for different types or lengths of cotton. A set of tests made for one count of yarn is not necessarily conclusive for another, so the field for investigation is almost limitless.

COMPREHENSIVE YARN TESTS NEEDED

It is really an enormous task, that of trying to definitely assign the results to their causes in this particular textile operation. While tons of yarn are being mercerized and mercerized well, and the general conditions necessary are understood, such a detailed analysis as we have outlined, designed to find out the exact effects of even the most important variables, has never been reported.

There are accounts of yarn experiments, but while useful they are more or less fragmentary or based on indefinite conditions, and have been intended to determine mercerizing conditions rather than the necessary yarn characteristics. So far the most complete work is by Corser and Turner [3] and if our suggestion of the difficulties and uncertainties appears overdrawn, a careful perusal of their paper will bear us out for there are many points that we have not even mentioned.

Briefly, they spun 60's Egyptian yarns with three different twists, then each of the shingles was doubled with three different twists, making a total of nine types of yarn. One set was saved unmercerized, and one set mercerized by each of two methods, making 27 kinds of yarn. The yarns were compared principally for their physical properties (including luster which we have already discussed), tested for count, single thread and lea breaking strengths, and elasticity, or rather extensibility (which is a preferred word and seems to mean stretch before breaking, rather ehan true elasticity), the whole necessitating many thousands of separate tests.

For a given count made from a given fiber, mercerizing results depend on the two yarn properties, degree of

twist and amount of tension in mercerizing. Up to about 7 per cent extension the greater the tension in the process the stronger the mercerized yarn. Breakage became troublesome at this fixture. In twofold yarns with a given singles twist, best results in strength were obtained with a soft doubling twist. Best results of all were obtained with a medium doubling twist and soft or medium singles. The increases in strength are important for some special uses, and while varying in the different yarns and with the different testers, are of the order of 20 per cent. The loss of extensibility was about a third, or roughly a drop from 6 or 7 per cent to 4 or 4.5 per cent.

Since recorded results on single fibers show that they lose a few per cent in strength, increase in strength of yarn cannot be due to this factor. It is, rather, due to an increase in the clinging power of the fibers, partly from the removal of the cotton wax, which acts as a lubricant in gray yarn, and probably much more from the swelling of the individual fibers and their change of shape while at the same time the tension tends to make the yarn smaller in diameter. In other words there is a consolidating effect which increases the internal friction between the fibers in the yarn. Since yarn usually utilizes not over a quarter of the fiber strength in its cross section but breaks from the slipping of fibers, this explanation is very satisfactory.

Piece Mercerizing

There is very little published work on piece mercerizing, for the necessary experiments are in many respects even more complicated than those required for yarn. Just as yarns depend on the single fibers and the way they are put together, pieces depend on the same factors and in addition on the way the yarns are combined. With different combinations of yarn, different styles of weaving, and different effects desired, the field of investigation is still greater than that of yarn mercerizing.

In investigations by Huebner [12] the mercerized fabric appeared more open, the spaces between threads having become larger. The individual threads become smaller due to closer packing of the fibers in them, and their becoming straighter and more parallel. As a result the fabric lost 11.11 per cent in thickness. In more recent work the twenty-seven types of yarn made by Corser and Turner were woven into eighty-one types of cloth, but since their results are for strength rather than luster the reader is referred to the original paper [3].

Returning to the amount of swelling of loose fibers which can bring them up to nearly three times the original volume, it is obvious that any such effect will rarely if ever be realized in practical mercerizing. This is also clearly shown by Fig. 1 from the centrifugal experiments described in the last article. Since both were without tension the results should be comparable. The total swelling of a fabric is seen to be approximately half that of loose fiber, and the difference appears to be almost entirely due to mechanical resistance. It is certainly not entirely a question of difficulty of penetration. We can expect yarn to show results between the two and its greater freedom to swell in the caustic is no doubt the reason why yarns show better mercerization than piece goods.

Chemical Explanations Incorrect

Recent researches have led to rather definite views as to the cause of the new chemical properties that cotton shows after mercerizing, particularly its greater affinity for direct dyes, for hygroscopic moisture and its increased reactivity to certain reagents. These are now supposed to be due to changes in physical state just as great changes are brought about in other colloids by swelling. Harrison's work [11] in comparing iodine effects in cellulose and starches led him to the conclusion that mercerized cotton is or behaves like a more highly dispersed form of cotton, not cotton in smaller pieces; but swelling with an increase in surface has the same effect as a higher degree of dispersion with consequent greater surfaces of the colloid.

The simplest and oldest explanation of what we will somewhat inconsistently speak of as the chemistry of mercerization was given by the discoveror himself and has never been entirely disproved. As developed by Mercer and others since his day, the action of mercerization was held to be the addition in a chemical sense of a definite molecular proportion of caustic soda to cotton cellulose, followed by the decomposition of the resulting compound during washing and the replacement of the caustic by an equivalent amount of water which remained attached to the original cellulose. Several different formulas were assigned but much of the work has apparently not been complete enough as different investigators do not agree on the conclusions to be drawn from it. This view has not gained general acceptance, and perhaps most important is the fact that the presence of added water has never been proved.

Another class of chemical reaction has also appeared

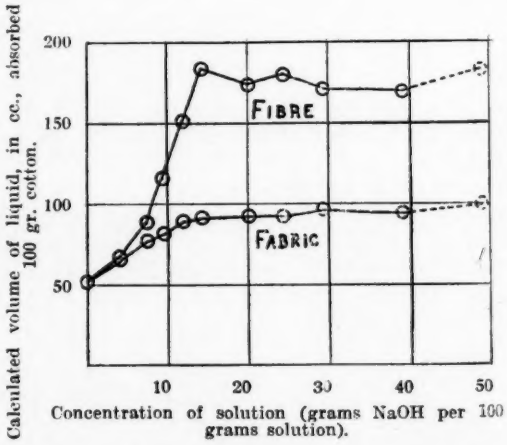

Fig. 1.—*Difference in Swelling Between Fiber and Cloth*

suggestive. Cellulose is analogous in some respects to the polyhydric alcohols, which have the property of forming compounds with sodium hydroxide, like the series of complex compounds formed between the trihydric alcohol, glycerol, and caustic alkalies. This theory is well discussed by Heuser [9] who bases his explanation

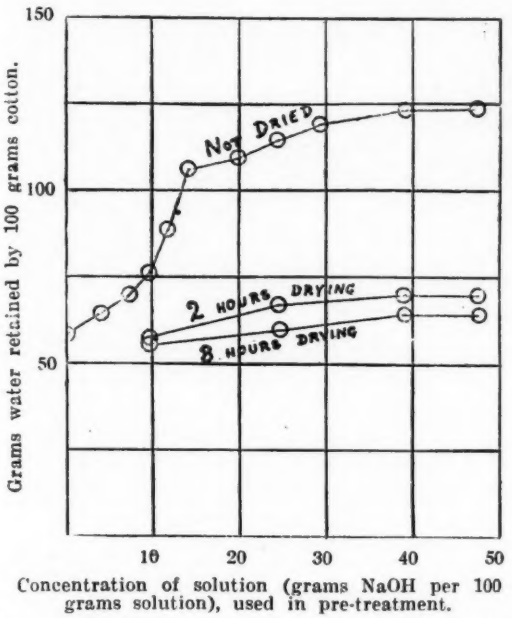

FIG. 2.—*Swelling of Washed and Dried Mercerized Cotton*

on ordinary alcohol. This reacts with metallic sodium to form sodium alcoholate and the latter decomposes in the presence of water forming sodium hydroxide, the second being really a reversible reaction:

$$C_2H_5ONa + HOH \leftrightarrow C_2H_5OH + NaOH \quad (1)$$

Turning it around, substituting cellulose for alcohol and writing the cellulose formula so as to show one hydroxyl group we have a rather attractive possibility:

$$C_6H_9O_4\,(OH) + NaOH \leftrightarrow C_6H_9O_5\,(ONa) + HOH$$

While the chance of there being such chemical reaction is borne out by the heat effect and the swelling of the cotton cellulose, the difficulty is that nobody has ever prepared "cellulose-alcoholate" free from objections, and it obviously cannot be made by the most characteristic reaction, the use of metallic sodium, for comparison with mercerized cotton.

According to analogy with other compounds the reversal of an alcoholate reaction, which would occur on washing with water, should yield the original cellulose, but mercerized cotton is very definitely changed in properties, even after washing.

Since cellulose is in the colloidal state and has the property of adsorbing materials from solution, the absorption of caustic by cotton is no doubt really adsorption, but since it is all washed out or neutralized there is none present to affect the properties of the final mercerized material.

Perhaps the broadest question of all is whether a sharp line can be drawn between solid solution (also proposed as an explanation) weak chemical compounds such as cellulose would form, and surface adsorption, and for practical purposes the difference may not be of great importance.

The final result is most commonly believed now to be due merely to a change of physical state. Other supporting evidence is the fact that the same swollen state can be produced by concentrated mineral acids and by certain salt solutions, accompanied by approximately the same changes in properties as found in mercerized cotton; and by the fact that chemical reactions on ordinary and on mercerized cotton, while they differ in speed, lead to the same products. In the first of these cases the swelling is the common feature, while in the second it is apparent that there can have been only a physical change.

It is now evident that the same hydrate-cellulose that has been applied to mercerized cotton is a misnomer.

THE COLLOID SIDE

These physico-chemical properties for which mercerized cotton is noteworthy, comprising a greater attraction for hygroscopic moisture from the atmosphere; a greater affinity for certain dyes, particularly the direct cotton colors; easier hydrolysis and a greater reactivity in general, can all be explained as a result of the swelling. In some cases it can be regarded as a step toward solution, and in others as the exposure of more surface to adsorption effects and reagents. The behavior is precisely similar to that of other colloids, and the likeness extends to a reversion toward the original condition on treating with alcohol or on drying, which is a case of gel dehydration.

The tendency of the structural elements of the cell walls to spread or open and the persistence of a part of this swelling as an increased surface can easily account for the extra attraction for moisture. Higgins found a difference of about 3 per cent at ordinary mercerizing strengths, and the amount of moisture has been found to increase with the strength of caustic that has been used.

The extra dye affinity does not require much discussion except for the fact that it sometimes causes trouble and conditions have to be closely controlled to avoid unevenness. From practical experience, as well as research, it is familiar that cotton which has been mercerized and has become partly dried out, will dye unevenly with many direct dyes, the parts that were dry coming out much lighter. Now this can be referred right back to irregular swelling of the fiber which probably means irregular openness of structure and consequent variable affinity for dyes. Knecht showed that the degree of swelling persisting after washing is intimately connected with its affinity for at least one dye, Benzopurpurine 4B.

The possibility of this intimate connection between the

different degrees of fiber swelling incident to mercerizing at different caustic strengths, to washing with water and to drying, and its dyeing properties are shown better than ever by recent work [6]. Swollen mercerized fibers do not wash back to their original volume but remain somewhat larger. Drying reduces the volume further but still not back to the original. The centrifugal method allows an exact measure of these new volumes because the amount of water that cotton will retain is a measure of the degree of swelling.

The results for loose cotton mercerized and not washed are shown in Fig. 1. The upper curve in Fig. 2 shows the absorption (swelling) after washing, and even though drawn on a different scale it is easily seen to be less by about 50 per cent of the weight of the cotton. The lower curves in Fig. 2 show the absorption after drying and they are lower by another 50 per cent, but they still leave the cotton swollen by 50 per cent as compared with the unmercerized. Such differences, even modified by the effects of twisting and weaving would be expected to cause very erratic behavior if they occurred together in mill production.

Research on mercerization is still going on and it is quite certain that the best and most valuable results are still to come. Carefully following such new work, even though it may appear at times quite impractical, will give a more intelligent view of the process, and in the end research and critical study of its results will lead to better mercerizing.

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The Bleaching and Dyeing of Cotton Goods by the Thies Method

Description of the Apparatus—The Dyeing Machine—The Principle of the Dyeing Process—The Dyeing of Loose Cotton—Dyeing Cotton on Spools—The Bleaching Process—Sulphur Colors in Dyeing by the Thies Process—Dyeing Blue Shades—Substantive Dyestuffs—Developed and Coupled Dyeing—Coloring with Beta Naphthol—Basic Colors

By EUGENE SCHMIDT

Translated from Textilberichte by Ismar Ginsberg

THE different products produced in the weaving or spinning mill are almost entirely dyed in the modern dyehouse in mechanical apparatus; numerous systems of machine dyeing devices are available at the present time. Of these various systems employed for this purpose by the textile industry, the present article deals with the one known as the Thies process. The article contains interesting and valuable information on the results obtained in practical operation with the use of different dyestuffs in this apparatus.

The installation may be divided into two main groups. First, there is the power plant in which is generated the power used in the second group, the collection of dyeing, bleaching and washing apparatus. The power station consists of one or two vacuum boilers, in which a constant vacuum is produced by means of a rotary air pump driven by an electric motor. The vacuum boiler is connected with the dyeing apparatus through a vacuum pipe line, and a control valve system is also provided on that line.

Description of Apparatus

The system of valves automatically connects the vacuum line with the dyeing apparatus and with the outside air. The entire arrangement of apparatus can then be again divided into two additional groups, consisting of two dyeing machines and one washing appara-

tus. Each of these dyeing machines is provided with a dye liquor container and a tank for catching the excess or overflowing liquor. This tank, which is located above the dye liquor container, is connected by means of a vertical pipe, eleven meters high, with the main vacuum line of a so-called auxiliary tank. This long, vertical pipe connection between the dye liquor catch-all and the auxiliary tank prevents the dye liquor from rising and overflowing into the vacuum boilers.

Valves are located at the auxiliary tank which connect that piece of apparatus with the individual dyeing, bleaching and washing apparatus and the vacuum line, making possible in this manner the operation of each of the separate pieces of apparatus as a unit.

The Dyeing Machine

The Thies dyeing machine is made in different types, dependent on the character of the material to be dyed in it. It is possible to dye in this apparatus in addition to loose fiber, threads wound on spools, yarns, warp threads, and different products of the spinning mill. The principle of the dyeing process remains the same; only the form of the apparatus changes in certain details.

In the case of loose material a container is provided for packing the material into the apparatus. This container is made of perforated iron plate and has a central tube with a conical part at the bottom. The conical device at the bottom of the vessel forms the connection between the pipe leading to the dye liquor catcher and the carrier which holds the material. In the case of material in the form of threads wound on spools, the material carrier is made in the form of a cylinder fashioned from sheet metal. The cylinder is provided with nickel spindles and the spools are placed thereon. These spindles are perforated, and the spools can be screwed fast to them. The spools can also be dyed in the apparatus of the pack type, but the author considers that this type of Thies machine is less suited for this purpose. Warp threads are placed on a perforated warp beam, which is placed in a vertical position in the apparatus, as are all the various devices employed therein for holding the material to be dyed in position during the dyeing process.

The Principle of the Dyeing Process

The principle of the dyeing process, as has perhaps been remarked, is the same in all cases, no matter what the character of the material being treated. The dye liquor in the dyeing machine is made to penetrate through the material on the carrying device, and thence it enters the dye liquor catch tank. After the catch tank is filled, then the regulating valve, which is located in the power house, is given an exact number of revolutions, and connection is automatically made between the vacuum line and the atmosphere, and the dye liquor is made to return from the catch tank into the dyeing apparatus by its own weight. However, the dye liquor does not flow wholly through the materials that are being dyed, but a part of the liquor is shifted through the spring valve on the center pipe in the container that holds the material being dyed and over this material back again into the dye bath. This alternate and interchangeable circulation of the dye liquor is accomplished periodically and without any interruption in its movement. The regulating valve makes it possible to control within any desirable limits both the duration of the circulation as well as the speed of the travel of the dye liquor by adjustment of the pressures and the vacuums which are maintained within the system.

The Dyeing of Loose Cotton

The loose cotton is packed into the material holder in a compact, uniform manner by means of a press. A certain amount of attention must be given to the packing operation, as, in order to obtain good results in the subsequent dyeing process, it is necessary to pack the loose cotton in a regular manner into the material holder. Two things must be therefore guarded against: Irregular packing must be avoided and too strong pressure must not be applied.

It is advisable to tear the strongly packed pieces from the bales, and in putting them into the container to sprinkle them with water. The well packed holder is then carried along on a traveling crane and placed in the dyeing machine which is full of the dye liquor. Then by opening the correct valves the dye machine is brought into connection with the auxiliary tank through the vacuum line.

At this point the dye liquor circulates regularly during the time that is required for the dyeing process, which in this case is generally one hour. After the dyeing process is completed the material holder is removed from the dyeing machine and is carried to a washing apparatus and the dyed cotton is washed with water. In the washing apparatus water circulates through the machine and through the dyed cotton in the place of dye liquor, the process of circulation being exactly the same in this case as when dyeing was taking place. There is, however, one difference and that is that the wash water from the dye liquor catch tank is not allowed to enter the washer again, but is made to flow through an automatically operating valve, which is located on the catch tank, into the waste flow-off conduit. This arrangement is constructed in such a fashion that the first wash water recovered from the washer is led back into the dyeing apparatus.

In the beginning special suction apparatus was provided for sucking off the liquor from the dyed goods, but it was found that this did not work out well in practice. At the present time the operation is conducted in such a fashion that the dye liquor which still clings to the dyed goods, as they are loaded into the washer, can be easily removed by the application of suction. This results in a very marked simplification of the entire process. After

washing, the goods in the washer are thoroughly sucked dry, the apparatus is then unloaded, the material is centrifuged and then dried.

Dyeing Cotton on Spools

The machine can be used in the dyeing of cotton wound on spools, thread for weaving the warp in fabrics and the like. Cross wound cotton spools are perforated and the thread must not be wound too tightly thereon. For, if this is done, the penetration of the dyestuff is not regular and poor results will be obtained in the dyeing operation. Of course, in order to obtain good dyeing it is assumed that the thread is properly wound upon the spool, and furthermore, that the spool itself has been properly perforated and is made of the proper material so as to allow easy penetration of the dye liquor. The same is true of the cotton used to weave the warp in fabrics. When these conditions are fulfilled a properly dyed product is obtained.

The Bleaching Process

The Thies machine is just as well suited for carrying out the bleaching of cotton products as for dyeing them. A few changes are necessary in the construction of the apparatus in order to make it available for the bleaching process. The bleaching apparatus, which is hence quite analogous to the dyeing machine, may be employed in the manufacture of bleached cotton goods and also for the treatment of cotton goods previous to their being dyed in light colors. The material holders are made from perforated nickeled steel plate, and the bleach vat from hard wood. The goods that are to be subjected to the bleaching process are first digested with soda solution and Turkey Red Oil, then washed and finally treated with a bleach liquor, containing sodium hypochlorite, at a temperature of 30 to 32 deg. Cent.

After the stock has been bleached, it is washed and scoured, then given an after-treatment with a solution of sodium bisulphite and finally blued with a solution of ultramarine. The bluing of the goods can also be carried out in the regular type of washing machine described above.

Sulphur Colors in Dyeing by the Thies Process

The author intends to give the details of a few methods of dyeing as they are carried out with the Thies apparatus, using different classes of dyestuffs and starting with the sulphur colors.

It was found that dyeing with the sulphur colors could be carried out very advantageously in the Thies apparatus. The dye liquor comes but little in contact with the air, and hence it is not subjected to rapid oxidation. In dyeing loose cotton material with Sulphur Black, the following proportions are employed per hundred kilograms weight of cotton:

Ingredient	Standard Bath Kilograms	Additional Bath Kilograms
Immediate Carbon B.....	8	5.5
Sodium sulphide	7	5
Calcined soda	2	0.5
Common salt	25	10

The volume of the dye liquor in the case of the standard bath is in all cases about one thousand liters on the average.

The liquor containing all these ingredients is then heated to the boiling point and dyeing is carried out at a temperature of 98 deg. Cent. for a period of one hour. The dye liquors containing sulphur colors are used over and over again, and from time to time the density of the bath is determined by means of a hydrometer, and if it falls too low the required amount of common salt is added to bring it back to the point where it should be.

Dyeing Loose Cotton Blue Shades

In dyeing loose cotton material a blue shade, the following proportions of ingredients in the dye liquor are used per hundred kilograms weight of the cotton:

Ingredient	Standard Bath Kilograms	Additional Bath Kilograms
Immediate Direct Blue B Concentrated	8	4.2
Sodium sulphide, concentrated.	9	4.5
Calcined carbonate of soda....	4	1
Common salt	20	5

After the material has been dyed and washed, it is after-treated with a warm solution of sodium perborate. As has been remarked, there are no difficulties encountered in the dyeing of cotton materials in the Thies apparatus with sulphur dyestuffs.

The after-treatment with a solution of sodium perborate causes the colors, particularly in the case of the blues, to assume a very marked brilliancy. Material dyed with Sulphur Black is given an after-treatment in the last wash bath with sodium acetate. Cotton wound on spools is treated after dyeing and washing with fat preparations in what are called brightening baths. A good color clearing or brightening bath may be made in the following manner:

15 kilograms of Turkey Red Oil, 50 per cent.
15 kilograms of Monopole soap.
3 liters of a 20 per cent. ammonia solution.
200 liters of water.

For each lot of spools there are used from six to eight liters of this liquor; the goods are treated with this brightening liquor for a period of twenty minutes at a temperature varying between 40 to 50 deg. Cent.

In dyeing textile products by the mechanical dyeing process in a machine of the type described above, it is advisable, as is well known, to select only those dyestuffs which are possessed of easy solubility and which produce uniform shades on on the materials dyed with them. The dyestuff is dissolved with the addition of a certain proportion of carbonate of soda, and the solution is made in hot water. The solution is cooked for a short time, then cooled and brought into contact with the cotton to be dyed while still in a lukewarm condition. Then, by gradually heating the dye bath, the liquor is brought up to the boiling point and the dyeing proper takes place at this temperature. The liquor is then salted out, the dye is sucked out of the dyed material and the matter is given a thorough washing.

Production of Light Shades

When light shades are being produced it is recommended that the cotton materials be first given a preliminary digestion with a solution of carbonate of soda and Turkey Red Oil. The addition of Monopole soap to the color bath, particularly when dyeing light shades, prevents irregular absorption of the dyestuff by the fabric. A very good color oil is Avriol KM. When this substance is employed with the properly selected dyestuff very uniform designs are obtained. A composition liquor which is said to give these goods results is as follows:

20 kilograms of Diamine Yellow M.
16 kilograms of Oxydiamine Orange R.
Half a kilogram of Avirol KM.

This liquor is used to dye eighty kilograms of cotton. The dyeing process is started at a temperature of 20 deg. Cent. The dyeing operation lasts for a quarter of an hour. Then the dyed material is taken out of the bath. The temperature of the liquor is then raised to 35 deg. Cent. and the material holder with the partially dyed goods is lowered into the dyeing machine once again and the dyeing is continued for another fifteen minutes. After this period of time has elapsed the temperature of the liquor is raised still higher until it reaches 100 deg. Cent. This is done by allowing steam to circulate through the double walls with which the apparatus is provided. When the dyeing operation is carried out in this manner it is possible to obtain at all times not only uniform dyeings but colors of a high degree of brilliancy.

Developed and Coupled Dyeing

An example is taken of this kind of dyeing in the case of Fast Yellows. The composition of the dye liquor is as follows:

4.9 kilograms of Primulin.
One kilogram of Avriol KM.
100 grams of calcined sodium carbonate.

This composition liquor is employed in dyeing 80 kilograms of cotton.

The dyeing process lasts forty minutes in the boiling bath and then the bath is salted out by the addition of sixteen kilograms of common salt. After dyeing the goods are washed with cold water and then the undeveloped dyestuff with which the goods are impregnated is subjected to diazotization by immersing the material in a fresh bath containing sodium nitrite and hydrochloric acid. After diazotization the goods are washed lightly in fresh cold water and the color is finally developed in the usual manner by treatment with a bath containing resorcinol. The colors obtained in this manner are very uniform.

Coloring with Beta Naphthol

Very fine shades, perfectly uniform throughout the goods, are also obtained by a similar process in which the dyeing is carried out as described above, but in which the color is developed by means of beta naphthol. The dyestuff, Fast Red, also gives very fine shades with beta naphthol when the dyeing is carried out in the Thies apparatus. The composition of the dye bath is as follows:

1.35 kilograms of Primulin.
0.3 kilogram of Oxydiamine Black SOOO.
0.25 kilogram of Cotton Brown N.
300 grams of sodium carbonate.
0.5 kilogram of Avirol KM.
12 kilograms of common salt.

This mixture will produce an olive color on eighty kilograms of cotton. After the cotton has been dyed, it is washed and then subjected to a coupling process in a fresh bath containing 1.9 kilograms of Nitrazol C. The diazotization and the development of the colors, as well as the coupling process, are best carried out on the materials in a nickel-alloy material holder.

Basic Colors

The coloring of materials with basic colors is carried out in a similar apparatus. For example, the following composition is used to produce a greenish color on 80 kilograms of cotton material:

10.5 kilograms of tannin.
3.6 kilograms of antimony salt.
1.3 kilograms of Brilliant Green crystals.
0.5 kilogram of Auramine O.
8 kilograms of acetic acid, 6 deg. Be.

The cotton material is given a treatment with tannin in a hot bath; then the excess tannin solution is well removed from the material, which is then fixed in a cold bath with the aid of antimony salt. The material is then thoroughly washed. The dyeing process takes place in a lukewarm dye solution and the solution is heated, as the dye bath has become rather exhausted, and the temperature is allowed to rise gradually until it reaches 80

(*Concluded on page 729*)

Dyeing by Colloidal Solubilization or Dispersion of Insoluble Coloring Matters— The S. R. A. Colors*

Early Experimentation—Dyeing Methods Tried—How Need for Special Dyes Arose—Evolution of S. R. A. Dyeing Methods—Achievement of a Range of Dyestuffs—Practicability of the S. R. A. Colors—Dyeing Mixed Goods

By G. HOLLAND ELLIS

THE interest shown in the dyeing of acetyl cellulose is very widespread and the methods employed or proposed have recently formed the subject matter of several papers published in various journals. While, however, the S. R. A. methods have been in bulk practice nearly a year and a half, and a full range of the dyestuffs has been in use for about a year, and substantially over a million pounds of Celanese silk have been dyed in all shades by their aid, so far they have received no authoritative exposition. The present paper describes the evolution and present stage of development of these subjects.

The great chemical, physical and mechanical difficulties involved in the manufacture of acetyl-cellulose filaments or fibers were finally overcome by the British Celanese Company, Ltd., with the result that Celanese has now become a commercial success and is firmly established in the various departments of the textile trade. Apart from the almost innumerable difficulties inherent in the actual manufacture of Celanese, there remained, however, the outstanding problem of its successful coloration. This, too, in its turn has now been finally overcome and full ranges of shades are being produced under commercial conditions, the dyeing being as cheap as, if not cheaper than, that of cotton or other artificial silks in similar high degrees of fastness.

Nearly twenty years ago it was shown that acetyl-cellulose absorbed certain types of existing commercial dyestuffs substantively, these being chiefly basic colors such as Chrysoidine, Methylene Blue, etc. The inferior absorption of or greater resistance to the direct cotton colors was also found to be a specific result of the acetylation of cellulose. Also it was shown that acetyl-cellulose possessed the remarkable property of absorbing simple primary amino bases, such as aniline, paranitraniline, amino-azobenzene, etc., which by various treatments, such as oxidation or diazotizing and coupling, yielded a variety of coloring matters on the fiber.

Little further work was done until the successful production of acetyl-cellulose in the form of filaments and yarns, with the attendant commercial possibilities, led to a resuscitation of interest in the tinctorial problems connected therewith.

Strangely enough, many of the new attempts at the dyeing of this material concerned themselves not with the coloration of acetyl-cellulose as such but in its deacetylated or partially deacetylated form. This was due to the fact that the production of all other artificial filaments derived originally from cellulosic materials involved a regeneration of cellulose as such after temporary chemical modification and differing only from the original probably in degree of hydration; and that these points naturally led to the association of certain classes of dyestuff with the successful dyeing of so-called artificial silk, with consequent efforts to utilize them for the newer material. Such attempts are described in numerous patent specifications under the names of Briggs, Richardson, Bader and others.

Other work took as its basis the accepted fact that, notwithstanding a considerable selective "affinity" in respect of certain dyestuffs, acetyl-cellulose displayed in the main a considerably lower portion of absorption of existing commercial dyestuffs than all other known fibers. The lines followed were therefore those of attempted augmentation of the dyeing powers by means of the treatment of the acetyl-cellulose with various agents, either in preliminary separate processes, as in the case of the application by Briggs and Palmer of thiocyanates, or during the dyeing process proper, as in the case of the use by Clavel of magnesium chloride, etc. The third branch of research was pursued contemporaneously by Clavel in Switzerland and by the writer, and concerned itself with the further elaboration of and perfection in the treatment of the material with simple primary amino compounds and the less complex amino-azo bases, followed by the various processes of synthesis to which these compounds were amenable to yield coloring matters within the substance of the acetyl-cellulose itself.† At the same

*From the Journal of the Society of Dyers and Colourists, September, 1924.

†It is interesting to note that in recent months several of the prominent continental dyestuff firms have begun to market under varied names, such as "Azonines" (Cassella), "Acedronoles" (B. A. S. F.), "Silkons" (Gr. E.), "Azaniles" (M. L. B.), the simple primary amino and diamino compounds, for example the nitranilines, anisidines, amino-azo-benzene, amino-azo-toluene, dianisidine, etc., for the dyeing of acetyl-Cellulose by diazotization and development. (Just about two years behind the times.)

time, Clavel and Stannicz, and also the British Dyestuffs Corporation, Ltd., carried out a large amount of patient "spade" work in extending the observations of the behavior of the new fiber to nearly all known typical coloring matters, both in the substantive manner as well as by mordanting.

Dyeing Methods Tried

Of these various methods, those which met with the earliest practical applications were those of hydrolysis or saponification, and dyeing with direct sulphur and vat colors; of the diazotization and development of amino bases, and of the straight dyeing of a few basic, azo and alizarine dyestuffs, some of which were after-treated with metallic salts. By the process of hydrolysis probably some 100,000 pounds of Celanese were dyed; but besides the general unsatisfactory nature of such a process, in that it did not preserve the finest qualities of the acetyl-cellulose, there were always the serious loss in weight to be contended with and extreme difficulty of achieving level hydrolysis, and thus level dyeing, so that it became clear that it would ultimately be advisable to discard the method.

The British Celanese Company invited the collaboration of Dr. Rene Clavel, who prepared some literature on the subject and under whose supervision the earlier general non-saponification methods were operated in bulk in the company's dyehouse; only to show in time, however, that the utilization of existing dyestuffs of various classes in attempts to produce a full range of shades in requisite degree of fastness was not likely to prove a commercial proposition. All this labor, however, led to a deeper and more complete understanding of the governing principles of the problem and it became possible to reduce the dyeing properties of acetyl-cellulose to comparatively simple and useful generalizations which if not invariably true were mainly so. These may be summarized in stating—

Firstly, that the substantive "affinity" of a dyestuff for acetyl-cellulose is roughly proportional to its basicity and likewise approximately inversely proportional to its acidity or to its powers of salt formation with bases. From this may easily be understood the comparatively high dyeing powers of the basic dyestuffs, many azo compounds and the simple amino bases, as against the feeble or totally non-existent dyeing powers of the acid and salt or cotton dyestuffs. Clavel, in Brit. Pat. No. 182,830/21, attempts to reduce these generalizations to rulings involving the numerical preponderance one over the other of various basic or acidic chemical groups in the dyestuffs molecule. Account should, however, be taken also of orientations of groups and other points which may materially affect the "basicity" or "acidity" of the coloring matter.

And, secondly, that the substantive "affinity" of a dyestuff is proportional to its molecular simplicity or inversely proportional to its molecular complexity or aggregation. Whether chemical or physical solution theories be correct for the dyeing of acetyl-cellulose, this second generalization probably resolves itself into the question of simple "accessibility" of the coloring matter to the material of the filament; that is, of the diffusion or non-diffusion through the semi-permeable membrane of the filament surface.

How Need for Special Dyes Arose

These theoretical considerations, then, together with the empirical observations involved in a large amount of practical experience, led to the conclusion that the only true solution of the problem lay in the synthesis for acetyl-cellulose of a series of specially designed coloring matters. So much admitted, the problem was, however, not easy. The generalizations deduced and just enunciated involved one pre-eminent and disturbing factor; namely, that those coloring matters which were considered by the writer as being most suitable for the substantive dyeing of acetyl-cellulose would of necessity be insoluble or of comparatively low solubility in water.

The first part of the new problem, therefore, lay in the achievement of a means of "solubilizing" such substances without permanent modification of their structures such as would defeat the object of preserving their intrinsic "affinity." One very ingenious solution on chemical lines has already been described by A. G. Green and K. H. Saunders; namely, the Ionamines (see this journal, 1923, page 10). In this series of compounds the solubilization of the true color base is effected by the introduction into the molecule of the external or omega sulphonic acid group, which is split off gradually by hydrolysis during the dyeing operation, itself yielding to the fiber the actual coloring principle, which is readily absorbed. The method, of course, is restricted to amino and ketonic compounds, but opens up already a very large possible range.

The cardinal difficulty likely (in the opinion of the writer) to be met in working on such chemical lines will be the realization of a full range of differently colored compounds which will hydrolyze within reasonable limits at approximately the same rate under similar conditions of dye bath acidity or alkalinity and temperature variation—a matter of great importance from the point of view of control in practical bulk dyeing; for it must be remembered that the vast majority of dyeings are conducted with mixtures of two or three dyestuffs. This is a point which seems to have been overlooked or not emphasized by commentators on the subject, though too much emphasis cannot be placed upon it. The research task of creating a practicable range of dyestuffs for any material is a dual one; first, the attainment of compatibility of dyeing

properties throughout the range, and, secondly, maintaining the requisite fastness properties.

Evolution of S. R. A. Dyeing Method

The S. R. A. methods of dyeing are the results of the conception of a means not of chemical but of "physical solubilization," or, better, "colloidal dispersion" of the ordinarily insoluble coloring matters in order to render them properly available to the fiber. Once the desirability of the attempted solution of the problem on these lines was established from the general theoretical considerations outlined, and also from practical considerations, research was conducted very intensively. The whole problem had, in fact, been placed in the hands of the writer, who had had the opportunity of observing nearly all the earlier evolution at the works of the British Celanese Company and of reviewing of the whole situation. It was a formidable task even with the help of a numerous and well-equipped chemical staff. Following up this conception, then, a large range of constitutionally feasible but ordinarily insoluble or insufficiently soluble compounds was prepared. Several chemical classes were represented, some being within the usual realms of tinctorial chemistry—as, for instance, the azo and amido-azo classes—and others being quite unusual as dyes. Various methods of "solubilization" were then tried. The earliest general success was obtained with sulphoricinoleic acid, the initials of which have provided a title for the methods and series. The results with this medium, as a matter of fact, were excellent. A large number of the coloring matters employed dissolved easily and directly in concentrated sulphoricinoleic acid, many of them appearing to form characteristic salts which were soluble in excess of the oil; as instance the color base of S. R. A. Orange I when treated with sulphoricinoleic acid yields a deep violet solution.

On pouring such solutions into water the dyestuffs usually remained sufficiently well dissolved to pass easily through filter paper or the customary dyehouse filter cloth and to yield successful dyeings.

It was then found that in most instances the aqueous dye baths so prepared could be neutralized or rendered alkaline often with advantage and without so influencing the degree of solubilization as materially to affect the value of the dyeings. Subsequent work showed that many other bodies of oleaginous characteristics and salt-forming properties or miscibility with water could be similarly utilized under different modes of treatment; for example, the simple higher fatty acids and their salts and others. It is to be remarked, however, that a dye-bath condition resulting from the addition simply of an insoluble coloring matter to water to which has already been added, say, sodium oleate solution would be very different from that obtained by first dissolving the compound in a sufficiency of oleic acid, neutralizing with aqueous caustic soda and pouring the mass into water. This can be readily understood, as the degree of ultimate dispersion obtained in the dye bath is governed by the degree of solution or dispersion obtained during the pretreatment. In fact, this attainment of solution by suitable pretreatment and the prevention of coagulation or aggregation afterward in the dye bath represent the two cardinal points involved in the S. R. A. methods.

Later work revealed that the property of promoting satisfactory solubilization in these respects was by no means confined to oleaginous bodies, but was inherent in a large number of compounds, and the use of these in detail and the whole methods in general have been the subjects of application for patent protection. As the result of systematic detailed studies of the subject on the basis of modern colloid chemistry and physics it has been found possible by these means to obtain with coloring matters insoluble in water, oil and spirit, aqueous dye baths practically as clear and transparent as water itself; and, further, to produce beautiful dyeings entirely free from any "surface" phenomena or tendency to rub off.

Achievement of a Range of Dyestuffs

Without necessarily bearing any reference to the members of the recognized S. R. A. series of coloring matters it may be interesting at this juncture to illustrate the wide variety of substances which may be dyed upon Celanese by these various methods of solubilization; the following represents a selection of a few bodies drawn from diverse groups: Benzene-azobenzene-azo-b-naphthol (Sudan III); Nitrobenzene-azo-b-naphthol (Para Red); Benzene-azo-dimethylaniline (Oil Yellow D); m-Nitrobenzene-azo-diphenylamine; 4-Nitro-2-methoxy-benzene-1-azo-diphenylamine; p-Acetamidobenzene-azo-x-naphthylamine; p-Amidobenzene-azo-naphthalene-azo-dimethylaniline; Aminoazonaphthalene; p-Aminobenzene-azophenyl-methyl-pyrazolone; Dimethyl-p-amidophenyl-1:4-naphthoquinoneimide (Indophenol Blue); a-Aminoanthraquinone; b-Aminoanthraquinone; 1-p-Tolylamido-4-hydroxyanthraquinone; Rosaniline base; Safranine base; Methylene Blue base; p-Nithraniline; Benzidine; Dianisidine; Amino-azotoluene; Di-p-methoxy-benzoyldiamino anthrarufin.

What remained after the establishment as a satisfactory working basis of this novel principle in dyeing in order to achieve the successful and practical coloration of Celanese in commerce were, firstly, the selection of one uniform and general solubilizing agent or "dispersator," and, secondly, the creation of an adequate range of coloring matters of satisfactory dyeing and fastness properties, commercially possible, applicable with this general medium and capable of mutual admixture. The medium for general use was soon selected. The creation of the requisite series of dyestuffs demanded, however, long and patient constructive researches. The special synthetic

preparation of feasible substances likely to be applicable by the methods was extended to some thousands, the work again being directed into the channels of known chemical classes of coloring matters, and also into new ones. A tremendous amount of elimination, often carried out reluctantly with disappointment, was involved as may be expected, largely on account of the high fastness standards imposed by the company. But very soon the nucleus of a useful range of dyestuffs was achieved and it is to be noted that the aforementioned generalizations drawn from the behavior of existing dyestuffs were well borne out in observations in these new insoluble compounds applied by the S. R. A. methods. Moreover, the work led to the foundation of more detailed laws governing affinity and fastness, and it certainly is to be stated that in the latter respect dyestuffs upon acetyl-cellulose conform far more closely to simple rules governing the relationships of their chemical structure to their resistance to washing, acids, alkalis and light than is the case with any other known fiber.

Further expansion of the initially adopted range was ultimately achieved to cover pure yellows, golden yellows, oranges, scarlets, crimson, violet-red, violet and blues, and two or three diazotizing colors (named Diazo Solamines) for the very deepest shades, thus yielding to the practical dyer a general method for obtaining his full range of shades. Satisfactory results with regard to fastness were assured by very careful and thorough tests upon dyeings both of individual dyestuffs and of typical mixtures for resistance to the following agencies: Light acids, alkalis, soaping (followed by rinsing), soaping (without rinsing), ironing, volatility, perspiration, rubbing, phototropy, cotton cross-dyeing, wool cross-dyeing with formic and sulphuric acids, general domestic usage, weathering, etc.

Practicability of the S. R. A. Colors

Recently the S. R. A. range of dyestuffs has been improved by the introduction of new and superior blue, violet and yellow dyestuffs. The writer is not able to disclose constitutions, but the tinctorial chemist will readily recognize that the present range of S. R. A. colors is drawn from several classes. The azo class naturally offers a prolific yield of potential S. R. A. dyestuffs, and a few have been found useful. An immense number of otherwise excellent yellows and oranges of this class has had to be eliminated, however, on the ground of the defect of "phototropy." This is rather a newly recognized defect in dyed fibers, though many compounds display the property in substance. Its discovery in respect of dyed acetyl-cellulose illustrates how warily the scientist must tread in unknown fields. But it is to be remarked that it is by no means confined to one range of acetyl-cellulose dyestuffs, namely the Celanese S. R. A. dyestuffs, other ranges proposed having exhibited it in their yellow and orange members. Unfortunately, although a very absorbing subject which promises to throw considerable light on the theory of the dyeing of acetyl-cellulose, space does not allow it to be dilated upon here from a scientific point of view. It is sufficient to record it as a defect likely to cause confusion and surprise in the dyers' examination room and manufacturers' or customers' hands, and one which led to the rejection of a very large number of otherwise promising dyestuffs. Its detection and the subsequent study which led to a knowledge of its causation and the means of its avoidance in dyestuff synthesis were the direct results of the system whereby all proposed coloring matters for Celanese after passing the laboratory stage are subjected to close scrutiny first in the experimental dyehouse, then finally in the company's commercial dyehouse before being incorporated in the selected range and issued for general use

From the point of view of excellent all-round fastness properties the anthraquinone series comes naturally to mind, and this group is not being neglected in the constructive work on the S. R. A. colors. But the importance of the anthraquinone series must not be overrated as far as acetyl cellulose is concerned. For violet and blue dyestuffs, molecular simplicity being a governing necessity, it is pre-eminently useful, but it has been found possible with yellow, orange and red S. R. A. dyestuffs of simple series to achieve dyeings at least equal in resistance to most other agencies and somewhat faster to light than those yielded by S. R. A. dyestuffs of similar shade derived from anthraquinone, and to achieve them at perhaps a quarter the price. Thus the whole question resolved itself into one of selection on the basis of commercial practicability consonant with adequate fastness. The matter of dyeing costs was always regarded as an essential factor; for it was recognized that the new range of dyestuffs would have to complete in price on the basis of tinctorial yield with those in use for other fibers to produce dyeings of similar fastness properties.

In bulk practice both in the British Celanese Company's large dyehouse and in outside dyehouses, the hopes entertained of the method of dyeing by these methods based upon theoretical and practical considerations have been justified, and the method can be considered as established. The commercially adopted series of S. R. A. colors as at present constituted are issued in the form of 10 per cent pastes which incorporate both coloring matter and medium or dispersing agent compounded by special means, being therefore immediately ready for use in the dyehouse without more trouble in dissolving than is usually involved. The S. R. A. colors are applied simply in the manner usual in direct dyeing methods. Soapy dye baths are recommended as assisting penetration and leveling, while, of course, helping to preserve the liquor in good condition. Manuals of practical dyeing notes on the S. R. A. colors are issued.

Dyeing Mixed Goods

It is hardly necessary to state that the coloring matters found most suitable for acetyl-cellulose should have least dyeing powers in respect of other fibers. Thus the whole

of the present S. R. A. range leave cotton and other artificial silks (of cellulosic nature) undyed. Of animal fibers, silk (except in the case of S. R. A. Pure Yellow I, which dyes animal fibers) resists well, though there is, as may be expected, considerable variation between different silks, while wool acquires some staining. Soaping in all cases improves the results, removing the small amounts of mechanically adhering color. It has been found possible in practice to apply the S. R. A. colors in the same bath with the "salt" or "direct cotton" dyestuffs, although the chemical incompatibility of the two groups would seem to militate against this. The practicability is due to the powerful protective action of the S. R. A. medium. To assist the cotton dyestuffs in the usual manner, salt in reasonable quantities may be added, though it is without any great beneficial effect in the yield of the S. R. A. colors themselves.

It will thus be seen that by employing suitable cotton dyestuffs it is possible by single bath dyeing to obtain on mixed goods of Celanese and cotton or cellulosic-artificial silk either totally contrasting shades, blending shades, or uniform effects at will. The great importance of this will be recognized by the textile designer, manufacturer, dyer, merchant and practical chemist. Several of the possibilities have as a matter of fact been well exploited both in woven goods of figured and "shot" effects, and in mixed yarns of Celanese and cotton, etc., for hosiery and general knitting purposes. These latter yarns have attained some popularity and publicity under the name of "Celfect." If it is not desirable or practicable for certain reasons to dye mixed fibers in one bath, it should be noted that two-bath methods may satisfactorily be employed since the S. R. A. colors are of good fastness to cross dyeing with direct cotton colors. Solid or different shades may also be obtained on mixtures of Celanese with wool or silk, since there is available a large number of neutral dyeing colors for these animal fibers which will dye in the same dye baths with the S. R. A. colors. The two-bath method may again be used if desired, as the S. R. A. colors may be dyed on the Celanese fiber, and the wool or silk afterward covered with the selected class of color. In this connection it should be stated that although some of the S. R. A. colors are fast to mineral acids, it is in general preferable to employ formic acid which all of them withstand sufficiently well.

OCTOBER MEETING OF THE DYESTUFFS SECTION OF THE S. O. C. M. A.

The regular monthly luncheon of the Dyestuffs Section was held at the Hotel Commodore, New York City, on Thursday, October 9, 1924, at 12.30 p.m.

The chairman introduced as the speaker of the day J. R. Minevitch, who had recently returned from a six months' stay in Russia, where he had had opportunity to observe at first hand both textile and dye manufacturing conditions. Mr. Minevitch said that in general conditions in Russia were slowly but gradually approaching normal. The pre-war consumption of dyes by Russia was estimated at 25,000,000 pounds, of which 5,000,000 pounds were imported. At the present time about 4,000,000 pounds are being produced annually, comprising for the most part sulphur and a few azo colors, and about 4½ million pounds are being imported. In other words, the textile mills are running at about 33 per cent of their pre-war capacity. The home industry is protected by strict embargo on those products supplied in sufficient quantity, and there is a high tariff on all dye imports. Russia needs intermediates in order to build up her own industry, but the German I. G. prefers to sell the finished product and does not care to supply Russia with intermediates, according to Mr. Minevitch. Practically all business is carried on through the All-Russia Textile Syndicate and the Aniline Trust. Mr. Minevitch read a list of prices of some of the more important dyes used in Russia, and also gave some figures showing the import tariff on dyes and intermediates.

It was voted to reconsider the action taken at the last meeting of the Section, and hold future meetings on the second Thursday of each month, at the same hour, in order to have the date coincide with the regular date for the meeting of the Board of Governors.

It was also voted that the next meeting of the Section be given over to round-table discussion of topics of interest to the members. The chairman urged each member to be prepared to submit and discuss some particular subject.

President Herty announced that copies of specifications of all chemical patents are now available at the association offices and that lists of these would be issued at frequent intervals in the Bulletin.

GATHER with members and friends from every Section at the Annual Meeting of the American Association of Textile Chemists and Colorists to be held in Philadelphia on Saturday, December 6th. Be sure to arrange your schedule to include the Get-Together Smoker at the Bellevue Stratford Hotel on Friday evening, December 5, 1924.

Proceedings of the American Association of Textile Chemists and Colorists

The American Association of Textile Chemists and Colorists

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THE IMPORTANCE OF SOFT WATER IN WOOL PROCESSING*

By JOHN H. CULVER
Chief Chemist, Firth Carpet Company

In this paper I shall attempt to cover only a few salient points in connection with the use of hard and soft water from the standpoint of wool processing.

It is interesting to know that on a basis of the weight of raw wool from three hundred to four hundred and fifty times the weight of water is used as the original weight of the raw wool it started with. On that account, considering the bulk of water used in wool scouring, dyeing, fulling, and so forth, and various wet processes, the quality of water is a great consideration.

Most waters are from rivers and smaller streams. River water, and, of course, all stream water, varies in its composition from one season of the year to another, depending upon the amount of rainfall. In the spring of the year when there is considerable surface water, and during periods when there is considerable rainfall the water will naturally be quite soft. On the other hand, during the fall of the year when there is very little surface water and during drought periods, the water will contain considerable hardness.

The hardness of water is chiefly due to the salts of calcium and magnesia, and is usually measured by the soap-destroying powers of the water. Sodium and potassium soap decompose hard water and form insoluble calcium and magnesium soap. The solubility of calcium and magnesium salts up to and beyond certain limits depends upon the amount of carbon dioxide present which produces bicarbonates.

On boiling, carbon dioxide is removed and normal carbonates are precipitated. The hardness which is removed by boiling is called temporary hardness; that which remains is termed permanent hardness and is usually in the form of sulphates and chlorides of calcium and magnesia.

But since water either for boiler feed purposes or for wool process work is seldom if ever boiled before use we are interested in the hardness of water only from the standpoint of its total hardness.

In the processing of a wool fabric from the raw stock to the finished yarn or piece goods, whichever the case may be, after proper belding, picking and so forth, the lime salts, in case it is a lime pulled wool, are removed by dusting as far as possible so as to eliminate as much of this undesirable substance as possible.

Wool varies from around 20 to 60 per cent of impurities, 50 per cent. of which are natural wool grease and oil.

It has been my experience, and the experience of others whom I know, when hard water is used for scouring, to omit soap in the first scouring bowl. There is no need of describing the various types of scouring equipment because we all know that scouring is generally conducted in three or four bowl scouring machines. There is alkali alone in the first, soap and alkali in the second, and two bowls for rinsing.

*A paper presented at the meeting of the New York Section of the American Association of Textile Chemists and Colorists, September 26, 1924.

As I said, soap should be omitted in the first bowl, soda ash or coal ash introduced, and possibly something like a mild alkaline substance such as trisodium phosphate which has a very strong detergent action, and conducted at the proper temperature and carried over to the second bowl where soap and alkali both are required.

The reason for omitting soap in the first bowl is that calcium and magnesium stearates, palmatates and oleates are considerably more insoluble than the corresponding salts of the natural wool grease; they combine with the natural wool grease to form a similar substance. Therefore, it is obvious that if soap is introduced we are simply building up the fatty content of that scouring bowl and contaminating the yarn with these insoluble calcium magnesium curds which ultimately cause faulty work in dyeing and finishing.

About 80 per cent of the natural wool grease is supposed to be removed thoroughly emulsified in the first bowl by the alkali. Emulsification takes place very readily at the proper temperature, around 125 to 130 degrees, and it is carried over to the second bowl where the remaining 20 per cent is removed by the addition of alkali to the sodium carbonate or potassium carbonate, sometimes trisodium phosphate, and a soda or potash soap.

As it reaches the third bowl, which is the first rinsing bowl, there will be, in case of hard water, considerable precipitation and fixation of these undesirable calcium and magnesium soaps in the form of a non-uniform protective coating. In some cases it is there as a veneering, somewhat uniform, but in most cases anything but uniform.

The character of the dyeing under these conditions in finished yarn shows about the same ratio of unevenness as the deposits shown in photomicrographs of wool fibers washed in hard water.

The supposedly clean wool as it is delivered from the last rinsing bowl goes on to the dye kettle, then is subjected to the acid dye bath, assuming we are using acid colors or a dye bath that requires acid present. Further decomposition of these insoluble soaps takes place, resulting in a protective coating which is absolutely impervious to penetrate even under prolonged boiling.

So a good many dyers have their troubles in producing level dyeing, and attribute that largely not to the water so much as to faulty dyes and changes in wool blends.

When the yarn is dyed in the raw state, of course, there is an opportunity to correct, or rather to cover up any unevenness and defects in the dyeing because it is subsequently dried, carded and combed, spun into yarn, doubled and redoubled, and any unevenness here and there is compensated for by twisting together—we might say reblending the raw stock although dyed.

When the yarn is dyed, however, and the finished goods are in the form of a dyed yarn, we have a different proposition to contend with, and in the case of hard water for delicate shades and tints it is next to impossible to get level dyeing results unless very extra precautions are taken in the scouring. Even under those conditions, unless the final rinse is effected with soft water we cannot expect to produce well and level dyed yarn, when light shades are involved.

There is in addition to the disadvantage of these insoluble soaps which become deposited on wool fibers and prevent penetration of the dye bath, other disadvantages which arise more directly from the use of hard water and that is in dyeing with certain acid colors, because of the fact that certain salts, particularly iron and aluminum, precipitate the dyestuffs in the form of insoluble color lakes, and thereby produce a sanding effect on the dyed goods.

Aside from that, calcium or magnesium has little effect on acid goods but does have quite a disastrous effect in appreciable quantities when chrome colors are involved. It is readily obvious, therefore, that considering the amount of water used in wool process work (the vast bulk, as compared with any other raw material that is used) the necessity of employing soft water is of very great importance.

WATER SOFTENING AND PURIFICATION IN COTTON PROCESSING*

By Carleton C. Adams

Of the Rockland Finishing Company

The branch of cotton manufacturing which is most concerned, from a textile standpoint with water and its impurities, is the finishing end of the business where the cotton must be bleached, may be dyed, printed or mercerized, and, finally, in most cases, must receive a finish of starch, softener or other material.

It would take too long to thoroughly go into all these branches of the business and discuss all the adverse effects and corrective measures in connection with the various impurities that might be in the water. Consequently, I will only touch the high points.

Of the several main divisions of finishing one of the most important, if not the most important, at least as far as the presence of impurities in the water is concerned, is the bleaching. This is so, first, because it is the initial operation and if not properly carried out may cause much trouble in succeeding operations, and second, because it requires huge quantities of water.

*A paper presented at the meeting of the New York Section of the American Association of Textile Chemists and Colorists, September 26, 1924.

The bleaching of cotton, as you all may recall, comprises in general the following operations: Washing, with water alone, of the gray goods which contain the natural impurities of the cotton and those artificially added in the gray mills, followed by a souring with acid; another wash, kier boiling under pressure with caustic soda or other alkalies, oftentimes together with some soap or emulsifying agent, chiefly to saponify and emulsify the fats and waxes; washing, souring and washing again, chemicking with hypochlorite to destroy coloring matter, washing, souring and antichloring, and finally, washing again one or more times.

The principal impurities in the water that may cause trouble are dirt and sediment, coloring matter, due to iron or organic matter, and excessive hardness.

If the coloring matter or dirt exists in appreciable quantity in the water the goods may come off spotted, streaked, gray in tint, or yellow, or some other color, depending upon the impurities present. Since washing with water is the last operation there is little if anything that can be done in the bleach house to improve the goods, and there is a limit to the improvement that can be effected later by the bluing and other material used in finishing.

I do not know exactly how much coloring matter can be present without causing serious trouble. It would naturally depend on the kind of coloring matter and the operation the cloth had to pass through after bleaching, aging, steaming, etc. I understand that the limit for iron is about one part per million. Probably more important than the amount of coloring matter in the water in most cases is the uniformity of this color content. During rainstorms the increase in color and also turbidity may be considerable, and this may catch a lot of goods that have been partly processed and give rise to several distinct shades in the finished product.

Dirt and sediment, being largely insoluble and undissolved by the chemicals used in bleaching, is a very undesirable impurity. It gets worked into the fiber throughout the many operations carried on, where the cloth is passed in rope form from one machine or container to another and many times through squeeze rollers. If much dirt gets into the fiber it may not only give the goods a gray appearance, but the grit present may later cause trouble in printing, scratching the engraved roller, etc.

The other principal trouble incurred with water in the bleach house is excessive hardness. This manifests itself more in the kier boiling than anywhere else, forming by interaction with the saponified fats and waxes or soap added to the kier insoluble soaps, which adhere closely to the fiber and cannot be completely removed by washing and souring, but must be soured and given an additional alkaline wash or boil.

Particles of these insoluble soaps if left on the fiber become flattened out and worked into the cloth, and later, by resisting the penetration of the color in the dyeing operations, cause light spots in the goods.

This hardness can be corrected to some extent by the introduction of soda ash to the kier which will convert the constituents causing hardness to insoluble forms which can later be removed from the goods with less trouble than the insoluble soaps. If the hardness is too great, however, there will be too much wastage of material and probable serious interference with the effectiveness of the boiling operation.

The many kinds of reactions and how far they go, involving the several constituents causing hardness; the various substances on the fiber and in the kier; the circulation of the kier liquor and the temperatures and pressures involved, would be a very pretty problem for theoretical study and research.

Another point in connection with hardness is that not only will the insoluble soaps be formed in the kier, but the hardness of the wash water will work against their removal so that it is a damaging action that is cumulative in character.

The allowable limit for hardness, from what I can gather from the literature and from practical experience, is in the neighborhood of 10 Clark degrees or about 150 parts of calcium carbonate per million.

The effect of the impurities in the water in the other departments of the finishing business I will only touch upon briefly. Wherever soap is used, and that is general all through the several departments, trouble will occur that needs no further mentioning. The term "soaps" also includes sulphonated castor or Turkey Red Oil and other assistants used in printing, dyeing and finishing.

Iron in the water will dull or sadden basic colors on the fiber by forming the blue-black insoluble ferric tannate with the tannic acid present and will, even in very small amounts, dull and darken Alizarine Red.

Dirt and coloring matter will dull the finish and throw it off color. This can be corrected to some extent by bluing and by the color of the other materials, starch, stearic acid, etc.

If the dirt is high and gritty in character it will cause trouble in the printing pastes, scratching the engraved rollers, causing snaps in the fine line printing and giving rise to color smears on the goods.

Our water supply at Rockland comes from a large brook or stream which has its principal source back about 8 to 10 miles in the Ramapo Hills, feeding from a large pond. On coming down from the hills it connects with two other streams, also fed from smaller

ponds, and finally connects with a chain of three small ponds about one-eighth mile apart, from which we get our water supply.

All these ponds are at considerable levels above one another, are dammed up, and are provided with underneath gates to allow any of the upper ponds to be quickly tapped to supply the lower ones which from the sudden pull on the water at the plant may lessen the supply considerably.

These ponds are all fed by springs, so that our water is both ground and surface water. The upper pond of this chain provides our drinking water, and we have a purification and filtration plant to render this safe and suitable. All these ponds provide excellent natural settling basins and a large amount of sediment is removed in them. We draw our raw matter from a considerable depth under the surface of the pond nearest the plant and by so doing avoid much fine sediment and surface scum. We use about 4,000,000 gallons per day on an average in processing our goods, most of which we used in the bleach house. Provision is made for using water from the filtration plant on some of the more delicate operations in the bleach house.

At the present time our water has a total hardness of 56 parts per million, or about 4 Clark degrees. Most of this is non-carbonate hardness. The iron runs about 0.13 part per million—the alkalinity to Methyl Orange is 42, color 40, and turbidity 5—all given in parts per million. The above figures represent nearly our average conditions, except the color, which is higher than usual. This condition of the water gives us practically no trouble in our bleaching or other operations in the plant.

TWENTY-SIXTH COUNCIL MEETING

The twenty-sixth Council Meeting of the American Association of Textile Chemists and Colorists was held at the Engineers' Club, Boston, Mass., on Friday afternoon, October 17, 1924.

The following members were in attendance: L. A. Olney, W. D. Livermore, W. H. Cady, W. C. Durfee, G. A. Moran, W. K. Robbins, W. M. Scott, R. F. Culver, J. F. Bannan and W. E. Hadley.

The program for the Annual Meeting to be held in Philadelphia on December 6, 1924, was discussed in detail. It was decided to hold a Council Meeting in Philadelphia during the afternoon of December 5. A smoker and get-together meeting will be held during the same evening. The morning session on Saturday, December 6, will include the business meeting, and arrangements are being made for the presentation of several interesting papers on timely subjects. The afternoon session will be devoted to the consideration of the artificial silk industry. The subject of the chemistry of artificial silk will be presented by Prof. Harold Hibbert of Yale University, who will have on exhibition a practical machine such as is used in the manufacture of this product.

Following the general presentation of the subject by Prof. Hibbert, various speakers have been secured to present papers on the different types of artificial silk. It was the opinion of the Council that an extremely interesting and worth-while meeting is assured.

The official headquarters of the Philadelphia meeting will be the Bellevue Stratford Hotel.

The program of the meeting will be mailed to each member shortly and it is confidently expected that the coming Annual Meeting will be the best thus far in the history of the Association.

W. E. HADLEY, Secretary.

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AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

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MORE ANENT COMPETITIVE CONDITIONS IN THE DYESTUFF MANUFACTURING FIELD

IN our issue of October 20 we published an editorial entitled "Co-operation Versus Competition," in the course of which we deplored the highly competitive conditions existing among the dyestuff manufacturers and, in particular, the tremendous duplication of research effort which is evidenced by the recent production simultaneously of several greatly needed colors by two or more different manufacturers.

This editorial has apparently attracted considerable attention and, judging from the tenor of the comments which we have received thereon, has been accepted, theoretically at least, by a majority of the dyestuff manufacturers as sound.

It is obvious, however, that in order to accomplish anything of a practical nature a very different frame of mind on the part of the dyestuff manufacturers will have to be cultivated from that which at present exists.

The following quotations from letters received appear to indorse our point of view. One of the smaller manufacturers writes:

> The views expressed in this article are right to the point, and no doubt something will have to be done to make it more worth while for manufacturers of dyestuffs to continue in business.

Another manufacturer, who has been remarkably successful in the production of a limited line of exceptionally high-grade colors, writes:

> The editorial quite expresses what I have advocated at various times in my intercourse with manufacturers. Co-operation of effort and elimination of waste is the big need in our industry. Talk it just as much as you can, and the heavier you make the "punch" the better I shall like it.

Another one of the more successful of the smaller manufacturers writes at considerable length and cites specific instances wherein his own work has been duplicated by competitors, with the result that products involving the expenditure of a great deal of money and effort in preliminary research have been placed on the market simultaneously by two or three concerns. For obvious reasons these specific instances cannot be mentioned. In the course of his letter, however, he says:

> Few criticisms are of value if they are favorable in every particular, because, obviously, they are assumed to lack frankness; so, in no fault-finding way, but in order to make my criticism of your editorial complete, I would refer to the first sentence at the top of the second column, page 694: "The survival of the fittest." I should amend that perhaps by saying: "The survival of the one which, for the time being, has the largest financial resources." The old story of the German Cartel abroad and the Standard Oil Company at home, in killing competition by price-cutting and then making the consumer pay for it later, is only too familiar.

This comment in regard to "the survival of the fittest" is echoed again by another commentator; who, however, takes a rather different angle. His remarks are as follows:

> You have fully hit the nail on the head in your statement that there is one last analysis—"the survival of the fittest."
>
> Is this not, however, the natural course of events in every industry? Competition is absolutely essential if an industry is to mature. There must be always an ever-active tendency to improve the products of the industry, and as any individual member of the industry excels the products of a competitor the improved products become more valuable and that member becomes stronger.
>
> Limiting productive work detracts from the rewards to which ingenuity is justly entitled.
>
> The dyestuff industry in this country has had but a short existence. Intensive work must be done if we are to excel our German competitors, with their past experiences and past knowledge. Competitive research will more quickly place us in a truly competitive position with Germany.
>
> The hardships of a pioneer are numerous and must be borne with fortitude.

Another correspondent again agrees with the editorial in theory, but questions the possibility of a satisfactory agreement upon the question of whom is best qualified to make certain colors. A portion of his letter is as follows:

> I have carefully read what you say on page 694 and it is naturally unnecessary for me to tell you that I agree with you fully; but—and there is always a "but" in things of this kind—who is going to decide as to who is best qualified to manufacture individual colors? And are we not going to be hounded by our patriotic Bolshevists the very

minute even so much as a meeting of the manufacturers takes place to try to guard their mutual interests?

From the above comments it is apparent that while the manufacturers are seemingly almost a unit in believing that competitive conditions in the domestic industry should be alleviated if the various units are to prosper, there is, nevertheless, no practical suggestion forthcoming as to how this result can be accomplished, and there is apparently even a certain element which believes that the application of the old law "survival of the fittest" is the real way to settle the matter. The REPORTER cannot agree wholeheartedly with this latter view. By this we do not mean that we advocate artificial conditions which would terminate the continuance in business of ones obviously unfit, but we do feel that a continuance of the extreme price cutting which has been in practice during recent years will eventually force out of business many units which are exceptionally well qualified from a manufacturing standpoint but which, perhaps, do not possess the necessary financial resources to enable them to withstand a long siege of manufacturing at a loss.

We still believe that there is business enough for everyone and that if the various manufacturers could get themselves into a frame of mind wherein they would be willing to co-operate with each other in a spirit of mutual helpfulness a system could eventually be worked out whereby all of them could make a reasonable profit and the consuming interests be served to better ultimate advantage than under present conditions.

THE SECOND ROUND

WHEN the Government announced last January that it would appeal its suit to recover the German dye and chemical patents sold to the Chemical Foundation Company, and when in March it issued its lengthy brief labeling as the product of error the noteworthy decision that Judge Morris had made in favor of the Foundation, it is quite probable that the contending attorneys mopped their brows, blew a dispairing sigh through their teeth and audibly consigned the entire case to the far side of the Styx.

Both the Government and the Chemical Foundation have now filed their briefs in the United States Circuit Court of Appeals, and are prepared to resume their habitual litigation in Philadelphia on November 10th.

The brief just filed by the Chemical Foundation consists of over five hundred pages of denials and defensive contradictions supported by strong arguments. The Foundation won its case in Delaware and it doubtless feels, with almost everyone else in the dye and chemical industry, that its hard-earned victory in the lower court was backed by the weight of law and evidence and should therefore stand.

The new brief again denies that any shadow of a conspiracy lurked behind the sale of the patents. It affirms, and justly so it seems to us, that should the Government win its case and the patents be returned to their German owners or bought by German or American agents, the true purpose of the original sale would be destroyed and its beneficial effects on the growth of our coal tar industry reversed. It is difficult to understand the illogicality of a government that first heroically acts to protect and foster its key industry and then, a few years later, seeks persistently to injure that industry by nullifying the results of its original action.

The brief further emphasizes the unprecedented conditions existing during the war which made it imperative for the Government to confiscate all alien-owned property. Had this property not been taken over, the brief maintains, its German owners and members of the German imperial family would have made millions in profits from a war which they were instrumental in promoting. It is pointed out that as a defensive action against the prevailing system of foreign espionage and propaganda, this war-time confiscation was entirely justified.

In its brief the Chemical Foundation tells of the amendment to the Trading with the Enemy Act that prevented the foreign owners of confiscated properties from collecting huge profits from their enterprises after the war. This amendment gave to the alien property custodian the unassailable right to dispose of as he judged advisable the property in his charge. And yet, strangely enough, those who bestowed that right upon the custodian are now stubbornly fighting to prove that he acted wrongly when he transferred the German dye and chemical patents to a specially organized corporation in order that American citizens might have the equal privilege of utilizing those patents in the interests of one of our most important industries.

One new point contained in the brief is worth noting. In answer to the Government's charge that Francis P. Garvan sold the patents while he was both alien property custodian and president of the Foundation, it is asserted that A. Mitchell Palmer and not Mr. Garvan sold the patents. This important point, apparently, was not made sufficiently clear, nor sufficiently convincing in previous briefs, as the Government has repeatedly questioned the legality of Mr. Garvan's double position.

It is almost certain that Judge Morris's decision in favor of the Foundation will be affirmed in this new trial in the Court of Appeals. Judge Morris came to his decision only after weeks of close examination of every bit of evidence involved. Not one point did he allow to pass unchallenged. The results of this conscientious toil he embodied in a decision sound in structure, consistent and convincing. It seems impossible that other magistrates can so twist the evidence as to reverse this decision. In any case, the trial in Philadelphia should be the final action in the case. Let us hope that when it is over the Government will realize that further action is futile.

Foreign Dyes Imported Through the Port of New York During September

Compiled by the Chemical Division of the Bureau of Foreign and Domestic Commerce in Collaboration with the Chemical Division of the United States Tariff Commission

KEY TO ABBREVIATIONS OF MANUFACTURERS' NAMES

1—THE SIX LEADING GERMAN COMPANIES

A—Actien-Gesellschaft fur Anilin-Fabrikation, Berlin. Founded 1873.
B—Badische Anilin-und-Soda-Fabrik, Ludwigshafen-on-the-Rhine. Founded 1865.
By—Farbenfabriken, vormals Friedr. Bayer & Co., Leverkusen-on-the-Rhine. Founded 1862.
C—Leopold Cassella & Co., Frankfort-on-the-Main. Founded 1870.
K—Kalle & Co., A. G., Biebrich-on-the-Rhine. Founded 1870.
M—Farbwerke, vormals Meister Lucius & Bruning, Hochst-on-the Main. Founded 1862.

2—THE SMALLER GERMAN COMPANIES

BK—Leipziger Anilinfabrik Boyer & Kegel, Furstenberg, near Leipzig. Founded 1882.
CG—Chemikaliewerk Griesheim G. m. b. H., Griesheim-on-the-Main. Founded 1882.
CJ—Carl Jager G. m. b. H., Anilinfarbenfabrik, Dusseldorf. Founded 1823
GrE—Chemische Fabrik Griesheim-Electron, Offenbach-on-the-Main. Founded 1842.
L—Farbwerk Mulheim, vormals A. Leonhardt & Co., Mulheim-on-the-Main. Founded 1879
tM—Chemische Fabriken, vormals Weiler ter Meer, Uerdingen-on-the-Rhine. Founded 1877.
WD—Wulfing, Dahl & Co., A. G. Barmen. Founded 1842.

3—SWISS COMPANIES (ALL AT BASEL)

DH—Farbwerke vormals L. Durand, Huguenin & Co. Founded 1871.
G—Anilinfarben-und Extract-Fabriken, vormals Joh. Rud. Geigy. Founded 1764.
I—Gesellschaft fur chemische Industrie. Founded 1885.
S—Chemische Fabrik, vormals Sandoz & Co. Founded 1887.

4—DUTCH AND FRENCH COMPANIES

FA—Farbwerk Ammersfoort, Ammersfoort, Netherlands. Founded 1888
NF—Niederlandische Farben-und-Chemikalienfabrik Delft, Delft, Netherlands. Founded 1897.
CN—Compagnie Nationale de Matieres Colorantes et Produits Chimiques. Founded 1917. (Etablissements Kuhlmann merged with this company in 1923.)
P—Societe Anonyme des Matieres Colorantes et Produits Chimiques St. Denis (formerly A. Poirrier). Founded 1830.

5—ENGLISH COMPANIES

Bro—Brotherton & Co., Ltd., City Chambers, Leeds.
BAC—British Alizarine Co., Ltd., Manchester
BD—British Dyestuffs Corporation, Ltd., London.
Cl Co.—The Clayton Aniline Co., Ltd., Clayton, Manchester.
CV—The Colne Vale Dye & Chemical Co., Ltd., Milnsbridge, Huddersfield.
Hol—L. B. Holliday & Co., Ltd., Huddersfield.
Scot—Scottish Dyes, Ltd., Grangemouth.

THE imports of coal-tar dyes for September, 1924, through the port of New York totaled 152,743 pounds, with an invoice value of $152,477, or more than double the imports in the previous month. In addition, imports of dyes through other ports include: Providence, 5,935 pounds, with an invoice value of $5,628; Hartford, 2,000 pounds, with an invoice value of $981, and Milwaukee, 300 pounds, with a value of $534.

Of the total dyes imported for consumption included in this report, 33.7 per cent by quantity was imported September 1 to 21 and 66.3 per cent after the tariff reduction, September 22 to 30.

Imports of Dyes Through the Port of New York, 1924

Month	Pounds	Value
January	288,743	$232,571
February	158,874	176,657
March	293,862	302,016
April	174,880	182,253
May	167,245	165,521
June	167,245	165,521
June	147,380	151,331
July	140,810	137,075
August	64,546	71,290
September	152,978	159,620

Five Leading Dyes by Quantity Imported

	Pounds
Indanthrene Golden Orange R	10,297
Xylene Light Yellow	9,920
Indanthrene Red BN	7,903
Indanthrene Golden Orange G	7,516
Ciba Scarlet G	6,560

Per Cent of Quantity by Country of Shipment

Germany	50	Canada	2
Switzerland	35	England	1
Italy	6	Belgium	1
Holland	4	France	1

The total imports of medicinals, intermediates, photographic developers and other coal-tar chemicals for the month of September were 76,770 pounds, with an invoice value of $17,450. Of this quantity, 79 per cent was imported during the period September 1 to 21, 1924. The poundages given are approximate, because a small quantity of the medicinals were reported in ampoules, the exact weight of which is not known.

Month	Pounds	Value
January	201,271	$48,116

Month	Pounds	Value
February	55,094	16,870
March	212,343	46,254
April	21,550	22,789
May	17,534	7,001
June	106,127	22,669
July	5,718	10,245
August	4,332	8,062
September	76,770	17,450

Imports of Color Lakes

January	None	None
February	4,181	$1,848
March	11,520	3,343
April	2,956	2,143
May	3,421	1,034
June	330	463
July	390	320
August	250	...
September	1,850	1,281

The dyes in this report are grouped by Schultz numbers, and in the case of those which could not be identified by Schultz number the classification according to the ordinary method of application was adopted. As the pastes and powders of the vat dyes vary widely in strength and quantity, each vat dye has been reduced — in nearly every case — to a single-strength basis.

The designation of "†" for competitive and "*" for non-competitive indicates the appraisement basis for the assessment of the ad valorem duty in paragraph 28 of the Tariff Act of 1922. Those dyes without designation are doubtful, pending further investigation.

The ad valorem rate for competitive dyes is based on the American selling price, as defined in subdivision (f) of Section 402 of Title IV; the ad valorem rate for non-competitive dyes is based on the United States value, as defined in subdivision (d) of Section 402 of Title IV of the Tariff Act of 1922.

DYES OF COAL-TAR ORIGIN

This table includes imports through the port of New York to the amount of 152,743 pounds, and also 5,935 pounds from Providence, 2,000 pounds from Hartford and 300 pounds from Milwaukee.

Schultz No.	Name of Dye and Manufacturer	Quantity (pounds)
22	Xylene Light Yellow	9,920
	Xylene Light Yellow 2G Conc.—(S)	
28	Hansa Yellow G	1,000
	Hansa Yellow G Powder—(M)	
52	Orseille Red V—(Q)	11
48	Alizarine Yellow G	500
	Alizarine Yellow 2G Paste—(M)	
61	Victoria Violet	4
	Dahlia Violet—(Q)	
140	Curcumeine	220
	Chromocitronine R—(DH)	
143	Tropaeoline	11
	Mandarin Yellow—(Q)	
160	Fast Brown N	22
	Reddish-Brown Castor—(Q)	
182	Brilliant Sulphon Red	1,000
	Brilliant Sulphon Red B—(S)	
212	Acid Brown	2
	Direct Brown R—(Q)	
217	Naphthylamine Black	2
	Fancy Black—(Q)	
220	Palatine Black	1,500
	Pilatus Black SF—(B)	
	Wool Black GRF—(A)	
265	Sulphocyanine Black	909
	Acid Milling Black B—(G)	
273	*Diaminogene Blue	1,000
	Blue NA—(C)	
313	*Congo Rubine	300
	Congo Rubine B—(K)	
325	Columbia Blue R—(A)	25
332	Benzo Fast Red	500
	Fast Cotton Red 8BL—(A)	
339	*Brilliant Orange G	500
	Diamine Orange B—(C)	
348	Diphenyd Brown BN	551
	Diphenyl Brown BBNC—(G)	
354	*Direct Gray R	3,439
	Direct Gray R Paste—(G)	
358	Diphenyl Red	1,398
	*Chloramine Red 8BS—(By)	
	Toluylene Red—(GrE)	
363	Benzopurpurine 4B	220
	Universal Scarlet C—(C)	
364	Diazo Brilliant Black	110
	Diazo Brilliant Black B Powder—(By)	
387	Columbia Blue	100
	Columbia Blue G—(A)	
392	Toluylene Orange	661
	Direct Fast Orange K—(I)	
415	Dianil Blue G	225
	Universal Light Blue C—(C)	
476	Benzamine Brown 3GO	331
	Cupranil Brown G—(I)	
492	Turquoise Blue	22
	Turquoise Blue—(Q)	
503	Neptune Green	300
	Brilliant Milling Green B—(C)	
505	Light Green (Yellowish)	220
	Acid Green Extra Conc.—(C)	
512	Magenta	55
	Fuchsine N—(Q)	
515	Methyl Violet	2
	Methyl Violet—(Q)	

Schultz No.	Name of Dye and Manufacturer	Quantity (pounds)
516	Crystal Violet	222
	Crystal Violet Extra Conc.—(B)	
526	Acid Violet 4RS	11
	Acid Violet, Red—(Q)	
530	Acid Violet	11
	Acid Violet, Blue—(Q)	
541	Brilliant Dianil Blue 6G	50
	Brilliant Sky Blue 5G—(By)	
543	Patent Blue	1,390
	Patent Blue V—(Q)	
	Poseidon Blue BGX—(B)	
545	*Patent Blue A	400
	Poseidon Blue BR Extra—(Q)	
546	Cyanol	550
	Cyanol FF—(C)	
553	Eriochrome Cyanine	551
	Eriochrome Cyanine RC—(G)	
571	Rhodamine 6G	1,671
	*Rhodamine 6G Extra—(I)	
	*Rhodamine 6GDN Extra Powder—(B)	
	Rosazeine 6G Extra—(M)	
	Rosazeine 6GD Extra—(M)	
573	Rhodamine B	1,150
	†Rhodamine B Extra—(B)	
	†Rhodamine B Extra—(M)	
580	Fast Acid Violet	100
	Fast Acid Violet R—(M)	
606	Phosphine	441
	Patent Phosphine M—(I)	
608	Euchrysine	620
	†Patent Phosphine GRNTN—(B)	
	†Patent Phosphine RRDX—(B)	
617	Columbia Yellow	551
	Diphenyl Chlorine Yellow FF—(G)	
	Universal Yellow C—(C)	
627	Anthracyanine	441
	Chromacetine Blue S Extra—(DH)	
635	Modern Cyanine	110
	Blue 1900 TCD—(DH)	
663	New Methylene Blue	720
	New Methylene Blue N—(C)	
	*New Methylene Blue NS Conc.—(S)	
672	Azo Carmine GX	680
	Azo Carmine GX—(B)	
687	Rosolane O, T, R	100
	*Methylene Heliotrope Extra—(M)	
690	Metaphenylene Blue R	2,000
	Diphene Blue R—(A)	
695	Paraphenylene Violet	500
	Diphene Blue B—(A)	
698	Nigrosine (spirit soluble)	4
	Black Blue G—(Q)	
700	Nigrosine (water soluble)	1,111
	*Nigrosine T—(B)	
	Silver Gray—(Q)	
724	Immedial Blue	300
	Immedial Direct Blue B—(C)	
759	Anthraflavone G (sgle. stngth.)	2,183
	*Anthraflavone GC Powder—(B)	
	Anthra Yellow GC Paste Fine—(B)	
	Anthra Yellow GC Paste—(B)	
760	Indan. Golden Orange G (sgle. stngth.)	7,516
	Helindone Golden Orange IG—(M)	
	Helindone Golden Orange DIG—(M)	
	Vat Golden Orange G Dbl. Pst.—(B)	
	Vat Golden Orange G Powder—(B)	
761	Indan. Golden Orange R (sgle. stngth.)	10,297
	Helindone Golden Orange IRRT Paste —(M)	
	Vat Orange RRT Paste—(B)	
	Vat Orange RRT Paste Fine—(B)	
	Vat Orange RRTS Powder—(B)	
	*Vat Golden Orange RRT Paste—(B)	
762	Indan. Scarlet G (sgle. stngth.)	300
	Vat Orange 4R Powder—(B)	
765	Indan. Green B (sgle. stngth.)	400
	Indan. Blue Green B—(B)	
768	Indan. Violet B	15
	Vat Violet B Paste—(B)	
778	Alizarine Synthetic	5,676
	Alizarine VI Extra Pure—(B)	
	†Alizarine Red DIB New—(Q)	
794	Cibanone Black B (sgle. stngth.)	1,982
	Cibanone Black B New Paste—(I)	
	Cibanone Black 2G Powder—(I)	
795	Cibanone Yellow R (sgle. stngth.)	2,640
	*Cibanone Yellow R Powder—(I)	
804	Alizarine Blue S	834
	Alizarine Blue S Powder—(B)	
810	Helindone Yellow 3GN	15
	Vat Yellow RK Paste—(B)	
817	Algol Yellow R (sgle. stngth.)	3,200
	Vat Yellow GK Powder—(B)	
819	Algol Red FF, R (sgle. stngth.)	824
	*Vat Red R Extra Powder—(By)	
820	Algol Brilliant Violet R	103
	*Vat Brilliant Violet RK Paste—(By)	
822	Algol Brilliant Orange FR	400
	Vat Orange RRK Paste—(By)	
830	Indan. Red R (sgle. stngth.)	1,200
	Anthra Red RT Paste—(B)	
	Anthra Red RT Powder—(B)	
831	Indan. Red BN (sgle. stngth.)	7,903
	Helindone Red DIBN Ex. Pst.—(M)	
	*Indan. Red BN Ex. Pdr.—(B)	
	Vat Red RK Paste—(B)	
	Vat Red RK Paste Fine—(B)	
832	Indan. Violet RN	1,868
	*Vat Violet BN Paste—(B)	
	Vat Violet BN Paste Fine—(B)	
834	Algol Gray B	15
	Vat Gray GK Paste—(B)	

Schultz No.	Name of Dye and Manufacturer	Quantity (pounds)
838	†Inda. Blue RS (sgle. stngth.)	1,200
	Indan. Blue RS Triple Powder—(B)	
842	Indan. Blue GCD (sgle. stngth.)	6,178
	Indan. Blue GCD Dbl. Pst.—(B)	
	Vat Blue GCD Dbl. Pst.—(B)	
	Vat Blue GCD Dbl. Pst. Fine—(B)	
843	Indan. Blue GC (sgle. stngth.)	1,115
	Cibanone Blue G Powder—(I)	
	Vat Blue GC Paste—(B)	
847	Algol Green B	150
	Hydron Green G Paste—(C)	
849	Indan. Yellow G (sgle. stngth.)	2,900
	Indan. Yellow G Dbl. Pst.—(B)	
	Vat Yellow G Dbl. Pst.—(B)	
	†Vat Yellow G Dbl. Pst. Fine—(B)	
853	Anthraquinone Violet	110
	Anthraquinone Violet—(By)	
855	Alizarine Pure Blue B	1,020
	Alizarine Sky Blue B Powder—(By)	
856	Alizarine Astrol	220
	*Alizarine Blue AS Powder—(By)	
858	Alizarine Saphirol B	4,362
	Alizarine Blue SAWSA—(By)	
	Alizarine Light Blue B—(S)	
	*Alizarine Light Blue B Conc.—(S)	
860	Cyananthrol G	499
	Alizarine Direct Blue BGAOO—(B)	
	*Cyananthrol BGAOO—(B)	
862	Alizarine Blue Black	4,644
	†Alizarine Blue Black B Powder—(By)	
	Alizarine Blue Black B Powder—(M)	
865	Alizarine Direct Green G	511
	†Alizarine Cyanine Green G Ex.—(By)	
	Aliz. Cyanine Green 3G Pdr.—(By)	
867	Indan. Brown B	878
	Anthra Brown B Dbl. Pst.—(B)	
871	Indan. Red Violet RRN (sgle. stngth.)	200
	Vat Red Violet RRK Powder—(B)	
876	Indigo, White	110
	Indigosol DH—(DH)	
877	Indigotine	2
	Indigotine I—(Q)	
885	Brilliant Indigo B	838
	Brilliant Indigo B Paste—(B)	
886	Brilliant Indigo G (sgle. stngth.)	250
	Brilliant Indigo G Powder—(M)	
901	Ciba Violet B (sgle. stngth.)	1,692
	Ciba Violet R Powder—(I)	
904	Helindone Brown G	220
	*Helindone Brown G Paste—(M)	
906	Ciba Red G (sgle. stngth.)	3,310
	Ciba Red G Powder—(I)	
907	Ciba Scarlet G (sgle. stngth.)	6,560
	*Ciba Scarlet G Extra Paste—(I)	
	Helindone Fast Scarlet C Paste—(M)	
	Thio Indigo Scarlet 2G Paste—(K)	
910	Helindone Pink BN	500
	Vat Pink BN Paste—(M)	
911	Ciba Orange G	551
	Ciba Orange G Paste—(I)	
912	Thio Indigo Red B (sgle. stngth.)	500
	Ciba Pink BG Powder—(I)	
918	Helindone Red 3B	500
	Vat Red 3B Paste—(M)	
923	Ursol	25

UNIDENTIFIED DYES

Acid Dyes

Name of Dye and Manufacturer	Quantity (pounds)
Acid Black—(Q)	11
Alizarine Leveling Blue—(C)	1,000
*Alizarine Rubinol 3G—(By)	55
Black for Ostrich Feathers—(Q)	22
Erio Navy Blue—(G)	493
French Blue—(Q)	11
Guinea Fast Red 2R—(A)	200
Ink Blue BITN—(GrE)	300
Onis (Anthosine) 3B—(B)	277
Rubine 3G Powder—(By)	396
Wool Fast Blue BL—(By)	276
*Xylene Milling Orange R Conc.—(S)	100

Vat Dyes

Alizarine Indigo Brown R Paste—(By)	800
Algol Brown G (sgle. stngth.)	880
*Vat Brown G Powder—(By)	
Ciba Red 3B Paste—(I)	44
Cibanone Brown R Paste—(I)	220
Helindone Fast Scarlet G Paste—(M)	100
Hydron Bordeaux B, R	100
Hydron Bordeaux B Dbl. Paste—(C)	
Hydron Bordeaux R Dbl. Paste—(C)	
Hydron Brown	5,300
*Hydron Brown G Paste—(C)	
*Hydron Brown R Paste—(C)	
Hydron Orange RF Paste—(C)	661
Hydron Pink FB, FF Paste—(C)	731
Hydron Sky Blue FK Paste—(C)	525
Indanthrene Pink (sgle. stngth.)	2,693
†Anthra Pink R Extra Paste—(B)	
Helindone Pink IB Double Paste—(M)	
Vat Pink B Double Paste—(B)	
Vat Blue GGHZ, RHZ Powder—(B)	2
Vat Blue RC Paste—(B)	15
Vat Green GG Paste	400
Vat Yellow 3RT—(B)	15

Mordant and Chrome Dyes

Chromanol Black RVI—(DH)	55
*Chrome Brilliant Blue G—(G)	276
Chromorhodine BR—(DH)	110
*Eriochrome Red G—(G)	1,102

Name of Dye and Manufacturer	Quantity (pounds)
Metachrome Green 3G—(A)	10
Metachrome Blue Black 2BX—(A)	144
Metachrome Olive Brown G Powder—(Bro.)	600
Metachrome Red G—(A)	100
Pilatus Chromate Black B—(B)	100
*Ultra Cyanol B Conc.—(S)	200

Direct Dyes

*Benzo Fast Heliotrope BL—(By)	110
†Benzo Red 12B—(By)	403
Blue III, IV—(BC)	600
*Chicago Red III—(G)	366
Chlorantine Fast Brown 3GL, RL—(I)	2,204
Chlorantine Fast Green B—(I)	110
Chlorantine Fast Yellow 4GL—(I)	1,101
Developing Black OT—(C)	250
Diamine Catechine B—(I)	3,748
Diamine Catechine G—(C)	50
*Diamine Fast Brown R—(C)	500
Diazo Brilliant Green 3G—(By)	300
Diazo Brilliant Scarlet 2BL Extra, 6B—(By)	929
Diazo Fast Blue 6GW—(I)	220
*Diazo Fast Violet BL—(By)	276
*Diazo Fast Yellow 2G—(By)	551
*Diazo Indigo Blue 4GL Extra—(By)	550
*Diphenyl Catechine R Supra—(G)	110
Direct Black RMW—(C)	100
Direct Cutch Brown GR—(I)	1,102
†Polyphenyl Blue GC—(G)	485
Universal Blue C—(C)	5
Universal Bordeaux C—(C)	5
Universal Brown C—(C)	5
Universal Dark Brown C—(C)	5
Universal Gray C—(C)	5
Universal Heliotrope C—(C)	5
Universal Leather Brown C—(C)	5
Universal Olive Brown C—(C)	5
Universal Violet C—(C)	5
†Zambesi Black D—(A)	500

Basic Dyes

Acridine Scarlet J—(DH)	55
*Brilliant Rhodamine Blue R—(By)	584
Methylene Gray B New—(B)	100
*Rhodamine Blue GO—(By)	55
Rhodamine Sky Blue 3G—(By)	55

Sulphur Dyes

Sulphide Black BL Extra Strong—(M)	25
*Thional Brilliant Blue 6BS Conc.—(S)	2,000

Unclassified Dyes

Fast Cotton Rubine 3B—(A)	5
Fast Cotton Violet 4R—(A)	5

Name of Dye and Manufacturer	Quantity (pounds)
Color Lakes of Coal-Tar Origin	
Alizarine Co'or 1054	1,000
Azure Blue 315 BK	750
Madder Pink FK	100

SUPPLEMENTARY LIST OF CLASSIFICATION OF DYES

For April—

*Phosphine 3R
*Hydron Brown G Paste
*Hydron Olive R Paste
*Diamine Scarlet 3B
*Hydron Scarlet 2B Paste
*Vat Scarlet G Paste
†Chinoline Yellow Soluble in Spirit
†Benzo Fast Yellow RL
*Black BR
*Vat Brown R Powder
*Sulpho Rosazeine B Extra
†Alizarine Blue Black B Powder
*Helindone Golden Orange IRRT Paste
*Alizarine Direct Blue A
*Helindone Brown IRT Paste
*Helindone Brown 1GG Paste
†Patent Blue V
*Helindone Fast Scarlet R Powder
*Neptune Blue BR
†Methyl Violet 5R
*Helindone Red 3B Paste
*Helindone Yellow AGC Paste
*Helindone Yellow AGC Powder
*Diazinil Pink B
†Azanile SR
*Azanile B
†Azanile R
*Azanile N
*Azanile G
†Dianil Fast Orange 2R
*Helindone Brilliant Blue IR Paste
*Diamine Orange B
*Alphanol Blue BRN Conc.
*Brilliant Cochineal 4R

For May—

†Hydron Pink FF Paste
*Vat Golden Orange RRT Powder
*Vat Golden Orange G Double Paste
*Vat Golden Orange RRT Paste

For June—

†Hydron Pink FF Paste
*Diamine Orange B
†Crystal Violet P
*Eriochrome Green L945
*Anthracene Brown RD Paste
*Alizarine Black WR Powder
*Vat Orange 4R Powder
*Vat Blue GGSZ Double Paste

†Vat Blue RZ Double Paste
†Anthra Brown B Double Paste
*Alizarine Direct Blue BGAOO
*Brilliant Indigo B Paste
*Vat Violet BN Powder
*Vat Orange RRT Paste Fine
*Vat Orange RRT Paste
*Vat Red RK Paste
*Vat Orange 3R Paste
†Vat Brilliant Violet RR Paste Fine
†Alizarine Cyanine Green G Extra Powder
*Vat Golden Orange RRT Paste
*Vat Red RK Paste
*Indanthrene Golden Orange RRT Paste
†Indanthrene Brown B Double Paste

For July—

†Indanthrene Blue GCD Double Paste
*Benzo Rhodamine Red 3B
*Diazo Fast Yellow 2G
*Chloramine Red 8BS
†Guinea Fast Red 2R
†Water Blue 67774 (large lumps)
†Developing Blue B
*Fur Blue Black SB
*Zambesi Brown 2G
*Brillianton Orange R
*Cotonerol AV Extra
*Cotonerol A Extra
†Wool Black GRF
*Brilliant Congo R
*Zambesi Pink B Extra
*Aceto Purpurine 8B
*Cotonerol A Extra
*Vat Red RK Paste
*Cyananthrol BGAOO
*Vat Red Violet RRK Paste
*Immedial Purple C
*Hydron Sky Blue FK Paste
*Cibanone Red C Powder
*Cibanone Orange 6R Powder
*Cibanone Orange 3R Powder
*Cibanone Blue 2G Powder
*Chlorantine Fast Gray B

For August—

*Wool Fast Blue BL
*Celatine Blue
*Diazo Fast Violet 3RL
*Rhodamine 6G Extra
*Vat Red RK Paste
*Vat Violet BN Paste
†Indanthrene Yellow G Double Paste
*Soudan OB
*Soudan AB

THE RED CROSS ROLL CALL

A wider appeal, made possible through the enlistment of hundreds of New York's leading professional and business men as volunteer workers and an elaboration of the committee form of organization of the city into various industrial, banking, mercantile and professional groups, characterizes this year's Red Cross Roll Call for memberships, which begins on Armistice Day, November 11, and continues until Thanksgiving.

William S. Gray, president of William S. Gray & Co., heads as section chairman a Chemicals and Drugs section in the campaign organization of the city. A special Colors and Dyestuffs group, a Chemical Manufacturers group (including explosives), and a Drugs and Sundries group will function within the Chemicals and Drugs Section to enlist the maximum response from the various lines. Plans of comprehensive activity are already in operation within the groups, and each group has set as its goal a 100 per cent Red Cross membership enrollment.

"Every possible aid for disabled ex-service men is our first responsibility," reads the annual report of the New York County chapter of the Red Cross, and various forms of help for the veteran and his dependants constitute a major part of its work. The variety of problems which the ex-service man faces, the majority of which he is helpless to solve alone, is indicated by the wide range of assistance which the Red Cross has found it necessary to provide, and which includes legal assistance, loans of money, advice on domestic matters and medical care.

More than $39,400 has been expended during the year by the chapter in relief for veterans and their families, and over 1,200 veterans, in addition to their dependants, are at present receiving financial and social care. Employment has been found, the year's records show, for more than 1,000 war veterans, of whom 75 per cent were disabled.

To help the man who is trying to help himself the Red Cross provides a center for all war veterans. Meals and lodgings at the lowest prices, study rooms and recreation rooms are maintained for his use. All funds for recreation are raised and administered by the veterans themselves. Within the past year more than 19,000 meals have been served at this Ex-Service Man's Club and 1,500 calls for lodging have been responded to.

Disaster relief also constitutes an important factor in the Red Cross program. Ready for any emergency, day or night, a force of workers is maintained to give help in the event of public disasters or emergency need. This force is prepared to give food, shelter, clothing and nursing care to all victims. Motors, canteen equipment, cots, bedding and clothing are kept in instant readiness for emergency, and more than 100,000 articles are held in storage ready for use. A force of 2,300 Red Cross nurses are enrolled in Manhattan, constituting a protective body instantly available for duty in any public emergency.

A USEFUL CATALOGUE

A new catalogue, entitled "Tycos Instruments for the Textile Industry," has been issued by the Taylor Instrument Companies. The unique feature of this catalogue is its index, in which all of the instruments described in the catalogue are classified, according to use in the various applications and processes, under the three main divisions of the textile industry—cotton, wool, and silk manufacture. As an example, the three pages devoted in this index to lists of instruments used in the manufacture of cotton goods are divided by headings embracing yarn processing, bleaching, mercerizing, dyeing, finishing, etc. Each of these sections in turn is subdivided. Under dyeing, for instance, the column is divided by headings into yarn, piece, jig, pad, beam and hosiery dyeing. In the adjoining columns are tabulated the various industrial, recording and index thermometers and temperature, time and pressure regulators recommended for use in each particular kind of dyeing, with the catalogue number and the numbers of the pages on which appear the specifications and illustrations of each instrument listed. The various accessories for each instrument are also listed, with their catalogue and page numbers. Thus, this index forms a compact, complete and convenient tabulation of all instruments used in the processing of cotton, wool and silk and in the various applications connected with each class of fiber.

This index covers only eight pages in the front of the catalogue. The remainder of the book contains detailed descriptions and specifications and numerous photographs, diagrams and charts of all of the instruments used in textile work, with their multitude of parts and accessories. Altogether, the book makes a desirable supplement to the foreman dyer's file of catalogues, and one that should prove of unique value when information is wanted on thermometers and regulators used in textile work.

BLEACHING AND DYEING COTTON GOODS BY THE THIES METHOD

(*Concluded from page 711*)

deg. Cent. After dyeing, the material is well washed with water.

The topping with basic dyestuffs of the cotton material which has been dyed with either direct cotton or sulphur colors, is best carried out in a washing machine of the type employed in washing loose cotton material.

Furthermore, the Thies machine is well suited for dyeing cotton materials with vat dyestuffs. Very excellent colors are obtained with the hydron dyestuffs. An example of a dye bath wherein this class of dyestuffs is employed is as follows:

	Kilograms
Hydron R powder	5
Sodiud hydrosulphite, concentrated powder	12.5
Sodium hydroxide, 40 deg. Be	12.5
Avirol KM	2

These materials are sufficient for the dyeing of one hundred kilograms of loose cotton.

The bath is heated up to a temperature of 50 deg. Cent., and to this bath are added both the dyestuff and the caustic soda lye. Then the hydrosulphite of soda is gradually stirred in and the agitation is continued until the solution is entirely reduced and changed into a yellowish color. The actual dyeing process takes about one hour at a temperature of 60 deg. Cent. Before dyeing the cotton is well wetted down with the Avirol KM in a boiling hot bath. After dyeing the material holder is removed from the dyeing machine and introduced into a washing machine where the materials are washed well with both cold and hot water. When the dyed cotton materials are given an after-treatment in a bath of sodium perborate, the brilliancy of the color is materially enhanced.

SIXTH SOUTHERN TEXTILE EXPOSITION

The Sixth Southern Textile Exposition was held at Textile Hall, Greenville, S. C., October 20-25 inclusive. It was remarkably well attended and a great deal of enthusiasm prevailed.

The only dyestuff house to exhibit was the National Aniline & Chemical Company whose display consisted primarily of a modern dyehouse on a small scale. The various units of laboratory dyeing machines, etc., were kept in continuous operation and were constantly surrounded by a throng of interested spectators.

Although primarily a display of textile machinery, some of the concerns more particularly associated with the chemical treatment of textiles, who exhibited were as follows:

American Dyestuff Reporter, New York; Borne, Scrymser Company, New York; Corn Products Sales Company, Greenville, S. C.; Eclipse Textile Devices, Inc., Elmira, N. Y.; J. B. Ford Company, Wyandotte, Mich.; Mathieson Alkali Works, New York City; Oakley Chemical Company, New York City; Powers Regulator Company, Chicago, Ill.; Procter & Gamble Distributing Company, Cincinnati, Ohio; Seydel Chemical Company, New York City; Southern Franklin Process Company, Greenville, S. C.; Stein Hall & Co., New York City; Taylor Instrument Companies, Rochester, N. Y.; Tolhurst Machine Works, Troy, N. Y.; U. S. Finishing Company, Cedartown, Ga.

The executive committee of the American Society for Testing Materials at its recent quarterly meeting decided to hold the twenty-eighth annual meeting of the society at Atlantic City, June 22 to 26, 1925, with headquarters at the Chalfonte-Haddon Hall hotels.

The Southern Mercerizing Company, of Tryon, N. C., processors of single yarns, are installing complete equipment for dyeing and bleaching cotton yarns. F. P. Bacon is president and treasurer.

Dyestuff Tables

A List of the Principal American-Made Colors with Their Properties and Fastness Characteristics

[NOTE: The publishers of The REPORTER have secured more or less complete data in regard to many of the dyestuffs which are at the present time being manufactured in the United States. As the following material has been brought together from various sources, they realize that errors are quite likely to appear, and it is earnestly requested that any readers who find errors or who are able to give additional information will communicate with the publishers in order that this material may be made as correct, complete and up to date as possible. These tables will appear serially until all colors upon which we have data shall have been covered. The publication of this data was begun in the issue of March 10, 1924.]

[Note.—The following group of four dyestuff tables, ranging from Schultz No. 146 to 159, includes American dyes that were not known to be manufactured in this country at the time the previous instalments of Dyestuff Tables were compiled.]

FUCHSINE G EXTRA
(Schultz No. 146)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Wool.

USUAL METHOD OF DYEING: Glauber salt and sulphuric acid.

SHADE: Similar to S-673.

SHADE BY GASLIGHT: Goes yellower.

SOLUBILITY: Good.

LEVEL: Excellent; can be used for shading at the boil.

EXHAUSTS: Very slowly.

FASTNESS TO:
- **Acid:** Fast.
- **Alkali:** Turns orange.
- **Fulling:** Will not stand fulling.
- **Ironing:** Fast.
- **Light:** Fast enough for ladies' dress goods.
- **Perspiration:** Fast.
- **Rubbing:** Fast.
- **Scouring:** Bleeds off.
- **Sulphur:** Fast.

OTHER PROPERTIES: Suitable for piece dyeing on carbonized material. Turns black when after-chromed.

ON UNIONS: Suitable for wool-silk unions, as the silk is left almost white.

PRINTING: Adapted for wool printing. Discharges yellowish with tin or zinc dust.

COMPETING PRODUCTS: Made in the United States by The Chemical Company of America under name of Fuchsine G Extra.

AZO FUCHSINE 6B
(Schultz No. 147)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Wool.

USUAL METHOD OF DYEING: Glauber salt and sulphuric acid.

SHADE: Bluer than S-146.

SHADE BY GASLIGHT: Duller.

SOLUBILITY: Good.

LEVEL: Excellent.

EXHAUSTS: Well.

FASTNESS TO:
- **Acid:** Fast.
- **Alkali:** Fast, though turns very slightly yellower.
- **Fulling:** Same as S-146.
- **Ironing:** Fast.
- **Perspiration:** Fast.
- **Rubbing:** Fast.
- **Scouring:** Same as S-146.
- **Sulphur:** Fast.

OTHER PROPERTIES: This color differs from the G mark S-146 in that it is much faster to alkali and dyes level better below the boil. It is a bluer shade, having the same general properties of the G mark, and comes into consideration in the production of fast acid navies. This color does not turn black on after-chroming, like the G mark.

ON UNIONS: Wool-silk unions: Dyed in a strongly acid bath, the silk is only slightly stained, as with S-146.

ON OTHER MATERIALS: Silk: Not as well adapted for this fibre as Azo Fuchsine G, as it does not go on the fibre as well and is not nearly as fast to water.

PRINTING: Suitable for direct wool printing on pieces and slubbing with acid.

DISCHARGING: The shade is discharged with tin and zinc dust.

COMPETING PRODUCTS: Made in the United States by Grasselli Dyestuff Corporation under name of Azo Fuchsine 6B.

FAST YELLOW R
(Schultz No. 149)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Wool.

USUAL METHOD OF DYEING: Glauber salt and sulphuric acid; rinse well.

SHADE: Reddish yellow.

SOLUBILITY: Good.

LEVEL: Excellent; suitable for shading at the boil.

FASTNESS TO:
- **Acid:** Redder.
- **Alkali:** Fast.
- **Carbonizing:** Fair.

Ironing: Fast.
Light: Excellent.
Steaming: Fairly fast.
Sulphur: Fairly fast.

ON UNIONS: Cotton-wool unions: Dyed neutral, not suitable. Dyed acid, the cotton is left white. Wool-silk unions: Dyed with acetic, silk is white.

ON OTHER MATERIALS: Silk: Dyed with boiled-off liquor and sulphuric acid, good in light shades; fast to light. Cotton: Not suitable.

PRINTING: Good on yarn and pieces.

DISCHARGING: Tin or zinc discharges the color white.

COMPETING PRODUCTS: Made in the United States by American Aniline Products, Inc., under name of Fast Yellow R.

ACID ALIZARINE BLACK R

(Schultz No. 159)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Wool.

USUAL METHOD OF DYEING: Top chrome.

SHADE: More on the violet than Diamond Black F (S-275).

SHADE BY GASLIGHT: Duller.

SOLUBILITY: Better than S-275; does not foam.

LEVEL: Same as S-275.

EXHAUSTS: Does not exhaust as well as S-275.

FASTNESS TO:

Acid: Fast.
Cross-Dyeing: Inferior to Diamond Black F.
Fulling: Inferior to Diamond Black F, especially with white cotton.
Light: Fades reddish; otherwise the same as Diamond Black F.
Potting: Inferior to Diamond Black F.
Sulphur: Fast.
Finishing: Superior to Diamond Black F.

SENSITIVE TO METALS, LIME: Very sensitive to copper.

OTHER PROPERTIES: In dyeing light percentages with this color it is very difficult to chrome the red over to a gray.

DYED BY OTHER METHODS: The shade of this dyestuff can be matched with 95 per cent Diamond Black F and 5 per cent Acid Violet 4B top-chromed.

COMPETING PRODUCTS: Made in the United States by Consolidated Color & Chemical Company (Selling Agents, H. A. Metz & Co.), under name of Acid Alizarine Black R, and Butterworth-Judson Corporation under name of Chrome Brown SW.

WOOL RED B

(Schultz No. 236)

COMPOSITION: Disazo.

SPECIALLY SUITABLE FOR: Wool.

USUAL METHOD OF DYEING: Glauber salt and acetic acid. Color should be dyed in a weakly acid bath or neutral.

SHADE: Bluish red.

SHADE BY GASLIGHT: No change in shade.

SOLUBILITY: Sensitive to hard water.

LEVEL: Dyes level only with great care; not suitable for piece dyes.

EXHAUSTS: Clear.

FASTNESS TO:

Acid: Fast.
Alkali: Shades go a little bluer.
Carbonizing: Fast.
Cross-Dyeing: Color will not stand cross-dyeing.
Fulling: Fair against white wool; stains white cotton and white silk.
Ironing: Shade becomes slightly yellower.
Light: Fast enough for ladies' dress goods.
Perspiration: Fast.
Potting: Bleeds slightly.
Rubbing: Crocks slightly.
Scouring: Severe scouring weakens the shade.
Steaming: Fast to dry steaming.
Street Dirt: Fair.
Sulphur: Shade turns yellower on stoving.
Washing: Fair against white wool; stains white cotton and white silk.
Water: Will not stand Markischer test.
Peroxide Bleaching: Color will not stand peroxide bleaching.

SENSITIVE TO METALS, LIME: Copper and tin dull the shade; iron changes the shade strongly.

MACHINE DYEING: Not recommended.

OTHER PROPERTIES: Top-chrome or chrome-mordant shade is duller and no faster.

ON UNIONS: Wool-silk unions: The wool is heavier than the silk. Cotton-wool unions: Dyed neutral, the color exhausts well on the wool. The cotton is slightly stained.

ON OTHER MATERIALS: Silk, weighted or unweighted: The color is not fast to water on this fiber.

PRINTING: Not of much interest on wool or silk.

DISCHARGING: Discharges white with sulphoxalates.

COMPETING PRODUCTS: Made in the United States by Cincinnati Chemical Works; National Aniline & Chemical Company; New England Aniline Works (Selling Agents, U. S. Color & Chemical Company); American Aniline Products, Inc.; Grasselli Dyestuff Corporation; Dye Products & Chemical Company; Garfield Aniline Works; Newport Chemical Works; Amalgamated Dyestuffs & Chemical Works; Palatine Aniline Company (Selling Agents, F. E. Atteaux & Co.).

The Theory of Mordants and Alumina

Requirements of a Mordant—Purpose of Mordants—The Use of Alterants—Mordants—Alum—Preparation of Alum—Its Properties—The Use of Alum in Dyeing—Acetate of Alumina

By W. B. NELSON

[EDITOR'S NOTE.—*This is third in a series of articles dealing with the vegetable dyestuffs used in dyeing textiles. The author is an experienced dyer and colorist of "the old school," and his writings will no doubt prove of interest to those who are still using the older natural dyes.*]

IF we took the many coloring matters used in dyeing cotton goods and found that they had an affinity of themselves for the goods in question, the process of dyeing the various colors would be a simple one; it would be only necessary to have a decoction of the dye and immerse the goods in it to insure their being colored the color of the decoction. But if we except Indigo (we are speaking of the vegetable dyes only at this writing), this is far from the case, as there is scarcely a dyestuff that gives its own color to the goods; in fact, the greater part of the materials used have so weak an affinity—for the cotton goods especially—that they impart no color of sufficient permanence to deserve the name of a dye. The cause of this can be made obvious. Take, for example, the decoction of a logwood. The coloring matter is held in a solution of alkali and water, and by putting a quantity of undyed cotton into this solution the fibers become filled with the colored solution, but if the cotton has no way of rendering the coloring matter insoluble and keeping it within its fibers, it is made quite plain that, by taking out that cotton and putting it into clean water, the dyeing matter within and upon it will be diffused through the clean water; in other words, the dye having no attraction for the fiber is washed out. This lack of affinity makes dyeing sufficiently difficult, and renders it dependent upon science; indeed, it is only by the nicest alignment of a few chemical laws that the dyer is enabled to turn to advantage the various coloring matters of which he is in possession. If the dyer finds that there is little affinity between the goods and any coloring substance of which he may be possessed, he endeavors to find a substance which has a mutual attraction for the cloth and the dyestuff, so that by combining this stuff with the cloth and then passing the goods through the solution, the coloring matter of the solution combines with the goods or rather with the substance which is upon them and constitutes a dye. This third substance used, which acts as a go-between, combining two inimical bodies, is termed a mordant, from the French *mordre*—to bite—from an idea which the old dyers had that these substances bit or opened a passage into the fibers of the cloth, giving access to color. Although their theories are now changed, the term is still continued, and perhaps further investigation will prove the term not altogether inapplicable. Nearly all the mordants are found among the metallic oxides, though there are a few notable exceptions to this rule. It must not be supposed from this that as metals are the most numerous class of elements, that mordants are very numerous also, for this is not so.

A substance must possess the quality of attraction among other properties before it can act as a mordant: it must have an attraction for the coloring matter so as to form an insoluble coloring compound with it. It must be easily held in solution so that it may readily enter into and permeate the fibers of the cloth. It should also have some affinity for the fiber itself, and a tendency to unite with it, but this is not entirely necessary; only the first two properties are so, i. e., attraction for the coloring matter and easy and complete solution of itself, and these limit the different mordants almost entirely to insoluble bases; that is to say, to compounds which are not of themselves soluble in water.

PURPOSE OF MORDANTS

The bases or oxides which are the most useful are alumina and the oxides of tin and iron; the two first are colorless, and the peroxide of the latter is brown and imparts to white goods a buff or nankeen color which in many cases affects to a considerable extent the cloth, a circumstance which must also be attended to by the dyer. Indeed, the principal part of all dyeing operations is the proper choice and application of the mordants; there being a chemical union between them and the coloring matter, a new substance is formed not only differing in properties but differing in color and from any of the originals; consequently a very little alteration in the strength of the mordant or its quality gives a decided alteration in shade of its color. However, this gives the dyer a much wider field for variety of shades and at the same time a fewer number of coloring substances are required, as, for example, logwood alone gives no color to cotton worthy the name of a dye, yet, by the judicious application of a few different kinds of mordants, all the shades, from a French white to a violet, from a lavender to a purple, from a blue to a lilac, and from a slate to a black, are obtained from this substance.

Before any chemical union takes place between bodies they must not only be in contact, but they must be brought into contact, element with element, or particle with particle; hence, substances used as mordants that are insoluble themselves in water must be dissolved in some appropriate menstrua before their particles can enter the fibers

of the goods or combine with the coloring matter. In doing this the dyer has often to attend to the degree of affinity between the solvent and the mordant to determine what force it will exert to prevent the mordant from combining with the fiber; should there exist an affinity between them an otherwise excellent mordant may be less effective by attraction of its solvents. As, an example, common alum, even though much concentrated, is but a weak mordant for cotton goods owing to the great attraction between the sulphuric acid and the alumina, but if acetic acid, which has a comparatively weak affinity for the alumina, be substituted for the sulphuric acid, it becomes a very much more effective mordant. From these things having to be attended to, the dyer has many beautiful illustrations of the relative attraction of different substances for each other. In some cases the dyeing compound formed between the mordant and the coloring being soluble, it may be kept well mixed, and the goods, when immersed in this solution, having a kind of reciprocal affinity, receive only their share. They do not extract the coloring matter from the solvent, but the depth of color on the cloth depends on the color of the solution. In other cases, the attraction between the mordant solution and the coloring matter is so powerful that if the least quantity of the mordant solution is left upon the cloth when put into the dye, it seizes upon the coloring matter, which it instantly precipitates or renders insoluble, and therefore unfit to combine with the goods, not only causing loss, but also uneven dyeing. In this case the goods passing through the mordant have a part of the base fixed in the fiber; they are then washed, or the solvent of the mordant otherwise removed.

Use of Alterants

From these circumstances the close alliance between the art of dyeing and the science of chemistry is seen, but an individual from experience may know these effects and, though ignorant of the cause, may often guard against their consequences; knowledge, however, procured by routine practice only is purchased at a very great cost and attended with many unpleasant circumstances. In cases where the base has no affinity for the fiber there exists the same difficulty, the fiber being filled with the solution of the base; should the goods so filled be passed through water the base will be washed out, and should they be put into the dyeing solution, a great quantity of the coloring matter will be precipitated upon the fiber and not in it and will thus be left merely adhering to the surface, and when dry much of it will come off as dust, which will cause much loss. For example, the simple protosalts of lead have little or no affinity for the fiber, and if the cotton impregnated with nitrate or acetate of lead be washed several times, nearly the whole lead salt is washed out. If put through a bichromate of soda bath directly from the lead, a great quantity of the chromate of lead will fall to the bottom of the bath and be lost, but by passing the goods from the lead solution through a little lime water, the lime takes away the acid, the lead is fixed within the fiber as an oxide, and when put into the chrome solution, combines with the chromic acid and no chromate of lead is precipitated.

Nevertheless, there are a few of the coloring matters that require a little of the freer mordant to be added to bring out the color. Thus, if a piece of cotton cloth be passed through red spirits and then well washed in water it will retain a great part of the oxide of tin. Let the cotton be now put into a solution of logwood and this will combine with the base or oxide of tin and leave the water of the decoction nearly colorless, giving a reddish brown color to the goods without brilliancy and not suitable as a dye; but by adding a small quantity of these spirits to the exhausted water or decoction and then immersing the dyed cotton again, instantly the dyed purple or violet color is brought out. The substance thus added to the colored liquor to change the colors are termed *alterants*, and the operation, in the language of the dyehouse, *raising*, because it brightens the color. Alterants and mordants are often spoken of as two different kinds of substances, but the only distinction is in the mode and the time of applying them. In some instances different substances are used. In the process detailed above, a little alum would do as well as the salt of tin, or if a particular bluish shade were wanted, a little pyrolignite of alumina, but in almost all cases the mordant may also be used as the alterant. This shows that in some instances the dye may require some of the acid in the salt which constituted the mordant to bring it out, and must be applied after the color is fixed. If, in the above operation the cloth had been passed through a hot logwood solution directly from the spirit tub, a great part of the logwood would have been precipitated, and unless the decoction had been very strong, the color upon the fiber would have been weak and unequal.

Other matters are often added as a sort of alterant to some colors, not to affect the required change of color, but to take up some substance that may have a tendency to retain the coloring matter and prevent its uniting with the mordant. Thus, it may be necessary with some lead mordants, where the acid of the lead is taken away, to add some acid to the chrome solutions to combine with the potash, in order to liberate the chromic acid and allow it more freely to take the lead. This is particularly the case with Prussian Blue. If the goods are washed from the nitrate of iron solution, or passed through an alkali, a little acid must be added to the prussiate of potash solution to take the potash and liberate the prussic acid.

Mordants

It is with the vegetable coloring matters, however, that the greatest attention must be paid to the many conditions and properties of mordants; some of these may be shortly explained.

The mordant, or solvent of the base constituting the mordant, should not be capable of injuring or destroying immediately, or by prolonged action, either the coloring matter or the fabric. Thus acids alone do not serve as mordants, and in cases where destructive acids are used

for dissolving the base, case must be taken that they are washed off or neutralized before they have time to act upon the tissue or upon the color. The action of bases upon colors, and the condition of those best adapted to give beauty and permanency, are most important subjects and deserve that we consider them more in detail.

The base being insoluble in water has to be rendered soluble by combining it with an acid, so as to allow the base to combine with the coloring matter. What becomes of that acid which holds the base in solution when the coloring matter combines with the base? Will it act upon the color formed? We have already discussed this point as regards lead and chrome; we will now take another color, which, though strictly speaking does not embrace the action of the mordant, will serve very well to illustrate the point of inquiry. Indigo is insoluble in water, but is dissolved in strong sulphuric acid, forming sulphonate of indigo, and is used for dyeing green upon light cotton cloths. The goods are first dyed yellow by a decoction of quercitron bark or fustic and then dyed blue by means of sulphonate of indigo which gives green, Now, were the yellow dye passed through the sulphonate of indigo as made, the acid would destroy the yellow and spoil the color; the acid has, therefore, first to be neutralized by an alkaline substance. If soda or potash be used, we have the sulphate of the alkali held in solution with the indigo, and although the acid will not destroy the yellow, there is another consideration, viz., the effect of this sulphate of the alkali upon the yellow color, and if there be an effect, it becomes a question how to avoid it. Thus, every circumstance produces a new feature and should be fully studied. Where fine, clear shades of green are concerned, the sulphates of the alkalis do affect the yellow dye, giving what the dyer calls a rusty tint; this is avoided by using carbonate of lime (chalk) instead of soda or potash, forming sulphate of lime, which precipitates, leaving a clear, blue solution of Indigo; in any case neither acid nor alkali should prevail. We must consider the nature and properties of the base constituting the mordant and its reaction upon the coloring matter, both in combining together, and afterward under exposure to the air. Thus, we have stated, when treating of the oxides of iron and tin, that these substances, under various circumstances, are unstable, the protoxide having a strong attraction for oxygen, and the peroxide, when in contact with organic matters, readily yielding oxygen. In one or the other of these conditions the bases combine with the coloring matter; how, then, will the above properties affect the compound? We will follow this up under the head of "Iron," and also other matters pertaining to tin and other mordants.

The property which the fiber possesses of fixing parts of the dyestuff within its pores will have to be referred to often, as it bears very important relation to mordants. What are termed astringent substances have a strong action in combining in this way with the fibers of cotton goods. A piece of cotton put into a hot decoction of sumac and remaining in it until cool, there is a quantity of the astringent principle, probably gallic or tannic acid, fixed upon the fiber, which no washing will remove. We have seen goods thus treated passed afterward through all the regular operations of bleaching, and still retaining so much of these substances as was sufficient to impart a black tint on passing them through protosulphate of iron. Hence, the astringent matters in many vegetable dyes act a very important part in the dyeing operations. Whether such substances as galls and sumac, which are used only for their astringent principle, may be called mordants, is a question we need not discuss, but they are essentially necessary for fixing within the fiber such quantities of the metallic base or mordant as are required to give depth and permanency to the color, and as these astringent matters produce tints with the bases they give a wider scope for variety of colors. Thus, if we pass a piece of cotton through a solution of protochloride of tin and then wash it in water, we will have a great quantity of oxide of tin fixed within by the operation of washing, and by passing this cloth through a decoction of brazilwood, and then *raising* with a little spirits, there is a fine though not very permanent rose red produced. If we pass the cotton through bichloride of tin, and then wash, there is very little oxide of tin fixed; for the bichloride is not decomposed as the protochloride is by the water. If, then, it be passed through the brazilwood in the same manner as the other, a color of less depth is produced, but if the cloth be previously steeped in sumac and then passed through the solution, even the bichloride, the astringent principle of the sumac combines with the tin and forms an insoluble compound, and there is thus fixed a great quantity of the metallic base upon and within the fiber which gives the color with the brazilwood, so that when immersed in the wood decoction there is obtained a color of great permanency and depth. But the compound formed between the tin and sumac gives a yellow, and thus peculiar tints of the color are obtained, instead of having a rose color, as was obtained without the sumac, a deep, rich red, between rose and scarlet is produced. Thus sumac, galls, etc., are extensively used in connection with metallic bases, to fix, modify, and impart depth to colors from which these bases are applied. The nature of these astringent substances are given under the distinctive matters which contain them.

We will speak now of some of the minerals which go to make up the mordants of which we have written.

Alum

Potash ammonium and sodium alum may be considered as the same thing so far as mordants are concerned. They differ only so far as price is concerned. This article, therefore, will deal only with potash and soda alum. This salt exists in a natural state in Italy, where the nat-

ural formation of alum may be easily explained. Where iron pyrites occur, associated with feldspathic rocks, the oxidation of the iron-pyrites (FeS_2) gives rise to sulphate of iron and free sulphuric acid, which combines with the alumina and potassa contained in the feldspar.

Alum is also obtained by mixing together hot concentrated solution of sulphate of alumina and sulphate of potassium when crystals of alum are deposited as the solution cools.

Potash alum is prepared from alum stone. The composition of this mineral is: $K_2SO_4Al_2(SO_4)_3 + 24H_2O$ (the composition ammonia alum is $(NH_4)_2 SO_4Al_2(SO_4)_3 + 24H_2O$). When this mineral is calcined, a portion of the alumina is converted into the insoluble form, and when the mineral is afterward treated with water, a quantity of alum is dissolved out; the washings are evaporated when they yield cubical crystals of alum. These crystals have a reddish color, from the presence of a little sesquioxide of iron in an insoluble state. This variety of alum is known as Roman alum or Rock alum, and is preferred by dyers, since its aqueous solution is always free from iron. It is at present prepared artificially, by mixing a solution of alum with a small quantity of carbonate of potassium, which precipitates any sesquioxide of iron which may be present, evaporating to crystallization, and coloring the crystals thus obtained with brick dust to make them appear like true Roman alum.

Preparation of Alum

Alum is, however, most extensively prepared from alum slate or shale which is a mineral of very common occurrence. Alum slate contains silicate of alumina, together with finely divided iron pyrites and more or less bituminous matter. Alum earth differs from alum slate more in its texture, which is soft and friable, and in its composition. The mineral is coarsely broken up, and subjected to a process of oxidation which generally consists either in exposing it to the continued action of air and moisture, or in throwing it into pyramidal heaps, with or without an additional quantity of combustible, and setting fire to these in different parts, letting them smoulder away till all the pyrites are oxidized. The production is better the more slowly and uniformly this operation is conducted. The roasted heaps are then allowed to remain exposed to the air till they are in a fit state for extraction.

Sometimes the heaps take fire spontaneously from the heat evolved by the oxidation of the pyrites; the workmen then smother the fire to prevent the loss of sulphur in the form of sulphurous acid, for it would appear that the sulphurous acid which is produced in those parts of the heap where the temperature is very high is absorbed by the alumina, and subsequently converted into sulphuric acid by the sulphate of sesquioxide of iron formed on exposing the protosulphate to the air. A certain quantity of sulphuric acid is also liberated, in consequence of the formation of a basic sulphate of sesquioxide of iron when the protosulphate is oxidized by exposure.

It is found advantageous to cover the heaps with exhausted ore which retains a quantity of sulphuric acid which would otherwise be lost. The oxidation of the heap requires at least from 10 to 24 months, according to the nature of the ore.

The change which takes place during this oxidation is easily understood. The iron pyrites is converted into sulphate of iron, while the excess of sulphur yields a quantity of free sulphuric acid: $FeS_2 + O_7 = FeO.SO_3 + SO_3$. The latter, acting upon the silicate of alumina, gives rise to sulphate of alumina. The sulphate of iron and the sulphate of alumina are then extracted by water and the solution evaporated to the requisite degree of concentration. In the above operation part of the sulphur also sublimes upon the outer and cooler portion of the heap.

Properties of Alum

The principal substances contained in this crude alum liquor are: Sulphates of iron, magnesia and alumina and soda, together with small quantities of the sulphates of manganese, potassium and calcium. The chlorides of magnesium and aluminum, sesquichloride of iron and free hydrochloric and sulphuric acids. The liquor always contains a certain amount of potassium alum (the potassium being derived from the shale itself, or from the wood employed as fuel) and of ammonia alum (unless too high a temperature has been used in the process of oxidation), the ammonia being derived from the destructive distillation of the coal.

The crude alum liquor generally contains a sufficient quantity of copperas to pay for extraction; hence the manufacture of this salt is usually carried on simultaneously with that of alum. Any persalt of iron which the liquor may contain is reduced by metallic iron and the solution is then boiled down to the point at which the green vitriol crystallizes out. In this manner a mother liquor is formed which is saturated with sulphate of alumina. The copperas is purified by recrystallization.

The liquor is now mixed with strong solution of sulphate of potassium, which salt is obtained as soap-boilers' waste, also from the saltpeter refineries and glass houses; this converts the sulphates (with the exception of sulphate of alumina) into chlorides, which, being more soluble, are more easily removed from the resulting alum than the sulphates would be. The due regulation of the amount of chloride of potassium removed, is of considerable importance, since an excess of that salt would give rise to the production of chloride of aluminum. The solution of the chloride is gradually added to the liquor, with constant agitation, and the *alum flour* is then allowed to subside; it is afterward drained and washed with a little cold water; it is then redissolved and by exposing it, in a perforated leaden funnel, to the action of steam and the saturated solution thus obtained is allowed to flow into wooden casks where it crystallizes.

The Use of Alum in Dyeing

Alum is found in commerce in large octahedral crystals; these crystals are quite colorless (in the case of ordinary alum), but those of Roman alum are of a brownish red color and are more basic in their character. The crystals dissolve in about two parts of water at 50 deg. Fahr., and about one-third their weight at boiling point so that a hot saturated solution of alum deposits the greater part in crystals in cooling. It must always be remembered that ordinary alum (free from iron) is a good alterant or raiser. Ordinary alum forms a weak mordant for cotton goods owing, probably, to the strong attraction which sulphuric has for the alumina; there are three proportions of acid to every two of alumina. But if we neutralize a portion of the acid, its properties as a mordant are greatly improved. This may be done by taking a quantity of carbonate of soda (or potash) in solution and adding this gradually to the alum solution, stirring all the time; the alumina is at first precipitated, but by keeping up the agitation, the precipitate again dissolves: continue until all the precipitate is again dissolved. In this state the alum is a more powerful mordant for the cotton, as the base is held more freely than by the sulphuric acid, and is readily detached by the superior affinity of the cloth to form a mordant; and thus prepared it is perfectly pure—any iron formerly present is precipitated by this process. Alum in this state is known as cubical or basic alum from the form in which it crystallizes. It is basic like the Roman alum, to which we have referred as being superior to other alums. This cubical alum, as it is termed, may be prepared on a large scale by boiling twelve parts of alum with one part of slaked lime. On cooling, the alum crystallizes or the solution may be used without crystallizing or an aluminum sulphate may be purchased and used in the same way as it can be used in preparing aluminates or mordants in the same manner as alum. Basic aluminum mordants are used in Turkey Reds and may be prepared as follows: Dissolve 40 pounds aluminum sulphate in 20 gallons of water, and add slowly to this a solution of 5 pounds of soda ash in 2½ gallons water. The basicity of the salt varies with the amount of soda used.

Sulphate of alumina is also used as a mordant for cotton goods or to prepare other mordants and is much used in preference to alum, and for most purposes it is quite as good.

Hydrate of alumina has a great affinity as a mordant for most coloring matters, and it is this hydrate which we have been trying to fix on the goods in all of the foregoing methods.

Acetate of Alumina

The most common, and we believe the best method of using alumina as a mordant for cotton, is by substituting acetic acid for sulphuric acid in combination with it. Acetate of alumina has several advantages over the sulphate; in the first place, the acetic acid is not so hurtful in its action upon the vegetable coloring matters; secondly, it holds the alumina with much less force than the sulphuric acid, and consequently yields it much more freely to the cloth; and thirdly, being volatile, a great portion of the acid flies off during the process of drying. When strong colors are wanted and the mordant is of such a nature as will admit of being dried, it is better to dry the cloth from the mordant previous to drying. This last property of acetic acid is, therefore, very convenient, as it frees the cloth from any superfluous acid which may have been in the mordant; besides it has been found that during the drying by heat, the soluble acetate has been converted into a less soluble subacetate.

The acetate of alumina is easily prepared by mixing a solution of acetates of barytes, lead or lime with alum. For all practical purposes the alum or sulphate of alumina and the lime is the cheapest and best. They can be made basic by the addition of soda ash or by adding hydrated alumina. The more basic the salt, the lower the temperature at which they dissociate. Aluminum hydroxide (hydrated alumina or alumina) is made by precipitating (until no further alumina falls down) a solution of aluminum sulphate with sodium carbonate. Pure aluminum hydroxide is obtained by adding ammonia to a hot decoction of this. It is often used for preparing other aluminum mordants. Aluminum sulphate is made of sulphuric acid and clay and is used in place of alum and is just as good for some purposes. Basic aluminum sulphates are obtained by adding soda ash (carbonate of soda) to sulphate of aluminum or alum thus: Forty pounds aluminum sulphate (or sulphate of alum) in 20 gallons water, and slowly add to this solution 5 pounds of soda ash dissolved in 2½ gallons of water. The basicity of the salt varies with the amount of soda used.

It must be remembered that hydrate of alumina is the one and only mordant required by the dyer, and that all his endeavors are to get that substance on the cloth; all the rest are merely assisting substances. Hydrate of alumina ($Al_2O_3 3HO$ or $Al(OH)_3$) is prepared by adding an excess of ammonium carbonate to a solution of alum or sulphate of alumina, heating for a few moments, filtering and washing, etc. It is a gelatinous precipitate and has a great affinity for most coloring matters forming compounds which are termed lakes. Thus, if a solution of alum be mixed with an infusion of logwood and an excess of carbonate of potassium be then added, the hydrate of alumina will form, with the coloring matter, a purplish red lake, which leaves the solution colorless. This property is turned to advantage in calico printing and dyeing where the compounds of alumina are largely used as mordants.

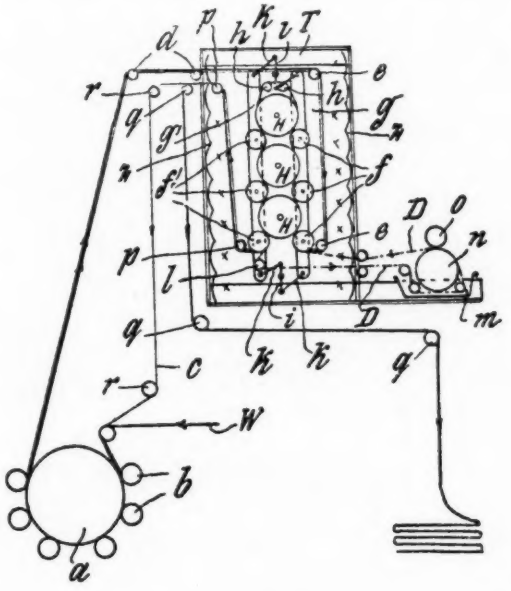
Red liquors and sulphates, as purchased, are largely used to-day in the dyeing and finishing of Turkey Reds. and shower proofing and in the making of other aluminum mordants.

Technical Notes from Foreign Sources

After-Treatment of Printed Fabrics

In German Patent No. 388,124 there is described a method for fixing, discharging and drying textile fabrics that have been printed. The apparatus used to accomplish these results is shown in the accompanying illustration. In this new apparatus it is possible to print the goods and then fix and dry the printed designs, or simultaneously to discharge and fix discharge colors used in printing fabrics, the operations being carried out in a continuous manner. Further, under certain conditions, it is also possible to dye the printed goods in addition to performing all the other operations on it.

The illustration shows the entire apparatus in diagrammatic form. The cylinder of the printing machine is shown at *a*. The printing rollers are seen at *b*, the carrying felt at *c* and the goods being printed at *W*. The goods, after being printed, are led over the guide roller *d* into a closed drying chamber *T*, wherein it is carried over the guide rollers *e* and finally emerges. In the lower part of the drying chamber there are located the wet or steamed cloth *D* so that the goods from now on run between the carrying felt *c* and the steamed cloth *D*. The cloth is made to pass over vertically-arranged guide rollers *f*, which press the cloth up against the electrically heated cylinders *H*. This dries the fabric.



Above the heating rolls there are located in a fixed position the guide rollers *h*. The cloth passes over these together with the other endless cloth belts and then passes over a second series of guide rollers *f'* to the other side of the drying chamber and is then made to come in contact once again with the drying cylinders *H*. Behind the guide rollers *f'* the wet cloth *D* is made to turn back by passing over a guide roller 1 and is then passed through the impregnating arrangement.

The cloth which is fixed, discharged or colored and dried in this manner passes over the guide rollers *p* and is finally led outside of the drying chamber. It is then separated from the carrying felt which has accompanied it all through the treatment and passing over the guide roller *q*, it is piled up in the usual manner. The carrying felt then returns to the printing machine over the guide roll *r*.

Treating Textile Fabrics with Rubber Latex

To the usual filling mixtures employed in treating textile fabrics there is added a certain percentage of rubber latex. For example, a filling mixture which may be applied by the methods used in common practice contains 25 per cent of farina, 3 per cent of rubber latex and 72 per cent of water. Dyes or pigments may be incorporated with these mixtures. Fabrics which contain rubber latex are almost impervious to moisture and retain their handle. The wearing qualities of fabric containing rubber latex may be improved by vulcanization by the usual methods. This process is patented in British Patent No. 217,973.

Dyeing Acetate Silk

Acid anthraquinone dyestuffs which contain carboxylic acid but not sulphonic acid groups, are suitable for dyeing acetate artificial silk. Such dyestuffs are obtained by condensing aminoanthraquinone derivatives with the sulphochloride of salicylic acid or by condensing a halogen derivative of anthraquinone with an aminocarboxylic acid, for instance, anthranilic acid.

For example, by condensing 1-5 dichloroanthraquinone with anthranilic acid a red violet dye is obtained. Other shades such as pink, blue and bluish green are also obtainable. The colors are all deep and fast and are dyed on the artificial silk fabric by the direct dyeing process. The process is patented in British Patent No. 207,711.

Arghan Fiber

This fiber has been creating considerable interest within the past year or so and it appears that it possesses considerable practical utility. In the Malayan Agricultural Journal, 1924, pages 185 to 190, the Columbian pita plant is described, which is a source of fibers that are much like those of this plant. The pita plant resembles a giant pineapple plant and carries from twenty to forty leaves, each ten feet in length and four inches broad. It grows well in a sandy loam soil shaded by taller trees. By hand decortication one hundred leaves—weighing 68 pounds—yield two pounds of dry fiber and about 1¼ tons of fiber in the dry condition should be obtained per acre culti-

vated. The dry fiber contains 74.7 per cent of cellulose, 9.8 per cent of moisture and 0.6 per cent of ash. The length of the ultimate fibers are 1.7 to 6.1 millimeters, mostly 3.0 to 4.2 millimeters. Cross and Bevan report that Arghan fibers, thought to be from a plant similar to the pita plant, have a breaking strength of 3.0 to 6.1 grams per denier, and an extensibility of 1.8 to 2.5 per cent. The fibers are remarkably free from lignone and are resistant to sea water and alkaline hydrolysis. If the commercial production is successful, pita fibers would compete with sisal in the manufacture of cordage, and particularly marine nets and ropes.

Kiers for Textile Materials

The usual type of high pressure kier is modified so that the textile material within it is continuously subjected to a cycle of treatmentts by which it is squeezed, allowed to swell, and then subjected to the action of a hot lye. At the commencement of the operations, cold lye is continuously circulated by means of a centrifugal pump, downward through the textile material, steam being admitted into the top of the kier. When the lye reaches a temperature of approximately 110 deg. Cent. its circulation is stopped and the steam is allowed to develop pressure in the upper part of the kier, thereby compressing the textile materials. Circulation of the lye is then started again, the steam supply is reduced, and the resulting condensation of steam within the top of the kier produces a partial vacuum so that the textile material swells and opens out. The lye delivered to the top of the kier is sprayed over the textile material within by means of a small Pelton wheel. The sequence of operations is continuously repeated during the period of kier boiling. For further details the reader is referred to British Patent No. 212,763.

Dyeing with Reduced Carmines

A process for dyeing with the colors commonly known as the reduced carmines is described in French Patent No. 561,307. The principal one of these reduced carmines is known as Reduced Black. These colors cannot be used in printing but they can be employed in the dyeing of both the animal and the vegetable fibers.

For example, in the dyeing of vegetable fibers a dye liquor is prepared which contains one hundred liters of water, from two to twenty kilograms of carmine or Reduced Black. The material being dyed is dipped into this dye liquor, the excess liquor is squeezed out of it and it is dried. Then the dye is permitted to undergo auto-oxidation, the dyed cloth being left until the next day. Thereafter the cloth is passed into a bath containing one hundred liters of water and about two liters of ammonia.

In the dyeing of woolen cloth reduced carmine or Reduced Black is employed to the extent of 10 to 15 per cent of the weight of the cloth, and the dyeing is carried out in an acid bath. The acid used is oxalic to the extent of approximately 1 per cent to which about 2 per cent of sulphuric acid is added. It is also possible to use simply from 2 to 3 per cent of sulphuric acid. It is found, however, that when oxalic acid is employed the black develops better.

Alizarine Red Discharge on Indigo

The following is an abstracted translation of an article which appeared on this subject in the Bulletin Mulhouse, number 6, page 376.

The textile fabric dyed in the indigo vat is printed with the following discharge composition:

One quarter of a liter of Senegal gum.
140 grams of Rongalite C.
140 c.c. of aluminum bisulphite 23 deg. Be.
50 c.c. of 40 per cent formaldehyde.
40 c.c. of calcium formate 15 deg. Be.

The aluminum bisulphite solution was made by introducing sulphur dioxide gas into an alumina paste containing 50 per cent of the salt. The cloth is steamed for five minutes in an air-free chamber, and the indigo is then reduced. The double combination between aluminum bisulphite and formaldehyde is decomposed with simultaneous fixation of the alumina on the fabric.

In order to remove the indigo white from the printed places on the fabric and so as to form the alizarine alumina lake at the same time, the cloth is passed through a boiling bath for two to three minutes, the bath containing 100 liters of water, half a kilogram of Alizarine RF (20 per cent) and the same amount of a one to one solution of Marseilles soap. Care must be taken to see that the guide roll on the machine remains constantly in the dye liquor, so that a partial reoxidation of the indigo white is avoided. The discharged places on the fabric are dyed in this manner a deep red. The cloth is then washed twice in boiling water and finally soaped. The soap bath serves to remove the excess alizarine which can dirty the blue background of the fabric if not removed in this way.

After the fabric has been dried, it is passed through a 5 per cent solution of Turkey Red Oil, dried again and steamed for one hour at half an atmosphere pressure. It is then soaped again for a short time. This is done particularly in the case where white is to be printed under red.

Such a white can be obtained very well by using the following composition:

Quarter of a liter of Senegal gum.
One hundred grams of Rongalite C.
One hundred grams of water.

The cloth which has been printed both with red and white, after it has been processed in this manner, must be washed in clean water until the white appears perfectly clean. The purity of the white is enhanced to a considerable degree by washing the cloth in a water bath which has been rendered alkaline with ammonia.

This process is known as the Haller process. The following experience has been noted with it: It was found that the oldest process used for discharging on indigo possesses the disadvantage of using chemicals (oxi-

dation with aluminum chlorate and subsequent coloring with alizarine) which attack the cellulose fiber and reduce its strength, particularly at the places where the printing is done. The use of aluminum bisulphite and formaldehyde in the afore-described process does not introduce anything that is injurious to the textile fiber. The alumina is firmly fixed on the textile fiber, and the indigo is completely discharged by a short treatment in an air-free chamber.

One of the main dangers in the practical operation of this process is that the leuco indigo will be reoxidized after the steaming operation with the result that the color of the alizarine discharge will be muddy. One of the principal advantages of the process is that it produces an article which is colored in fast shades. Other color discharge processes which have been suggested, such as by means of paranitroanidisine red or nitrosamine on indigo, may be cheaper than this process, but they possess the disadvantage of giving colors that are not fast to light.

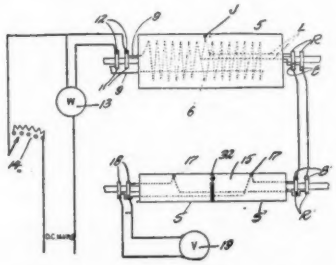
RECENT PATENTS

Instrument for the Automatic Determination of Moisture in Paper or Textiles

(1,508,516; September 16)

Arthur R. Harvey, Middletown, Ohio

In an instrument for the automatic determination of moisture content in a web while moving during its



course of manufacture, means for supplying heat to said web, means sensitive to the difference between the temperature of the heat supplying means and that of the web before being heated by said heating means, and an indicator under the influence of said heat sensitive means for indicating the moisture content of said web.

Dyestuff

(1,508,409; September 16)

Heinrich Friedrich Raeder and Walter Mieg, Vohwinkel, Germany, assignors to Farbenfabriken vorm. Friedr. Bayer & Co., Leverkusen, near Cologne-on-the-Rhine, Germany.

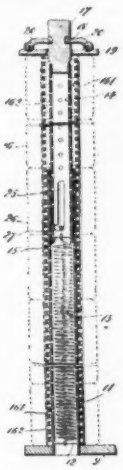
The herein-described new dyestuffs being sulphonic acids of aminodianthraquinonylamines, being after being dried and pulverized dark powders soluble in water generally with a violet to blue to green coloration; being almost insoluble in dilute acids and dyeing wool from acid baths from violet to grayish-blue to bluish-violet shades fast to light, substantially as described.

Apparatus for Treating Textile Fibers

(1,507,839; September 9)

Louis N. La Fayette, Plymouth, Mass.

In an apparatus of the kind described, a telescoping holder comprising two perforated tubes, one of which



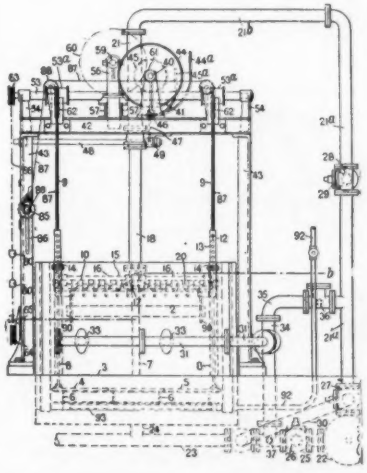
is free to slide within the other, said holder being adapted to receive a plurality of bundles of textile fibers, and oppositely acting means whereby bundles placed upon said holder for treatment will be kept in substantially balanced condition.

Machine or Apparatus for Dyeing and the Like

(1,507,779; September 9)

Joe Kershaw, Menston, England

In an apparatus of the class described, the combina-



tion of a vat, a vertically movable bottom therein, means for raising said bottom, and means automat-

ically operated during said raising movement for reversing the direction of movement of the bottom.

NEWPORT BINDER INSERTS

Newport Direct Fast Scarlet G, Direct Fast Scarlet 8BA and Direct Fast Yellow B are featured on the three latest inserts for the Newport binder. As given heretofore on these sheets showing swatch bows dyed with individual Newport colors, the application, notable properties, fastness properties and other useful data for each color are printed on each insert, so that a complete collection filed in the binder makes a reliable source of information about all Newport colors and assures better results in their use.

Leon W. Campbell, formerly of Providence, has joined the sales force of the Borne, Scrymser Company. His headquarters will be in Atlanta, Ga.

The American Chemical Society has issued a little booklet which gives complete details of the prize essay contest conducted by the society and lists the names of the winners of the 1923-1924 contest. The booklet includes letters from Francis P. Garvin, Dr. L. H. Baekeland and others approving the continuation of the competition. An interesting bibliography of chemical textbooks is appended.

North Carolina Textile School was fortunate to have on display a collection of fabrics gathered from all over the world. The collection is owned by M. D. C. Crawford, editor of the Daily News Record, New York, and valued by experts at over one million dollars. Mr. Crawford recently gave an address on textile research at the Made-in-Carolinas Exposition in Charlotte, and brought his collection south to aid in his address. After the display in Charlotte the exhibit was brought to North Carolina State Textile School for two days, during which time the exhibit was viewed by several thousand visitors.

R. P. Cargille has resigned his position as salesman for the Emil Greiner Company, and has established a selling agency at 74 Cortlandt Street, New York, where he will specialize in new products and appliances for the laboratory, and is desirous of communicating with those interested regarding such developments in dyestuffs.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1924, OF AMERICAN DYESTUFF REPORTER.

Published biweekly at New York, N. Y., for October 1, 1924.

State of New York, County of New York, s.s.:

Before me, a notary public in and for the State and county aforesaid, personally appeared Alfred P. Howes, who, having been duly sworn according to law, deposes and says that he is the publisher of the American Dyestuff Reporter, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 445, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business manager are:

Publisher—Alfred P. Howes, 90 William Street, New York City. Editor—Louis A. Olney, Lowell, Mass. Managing Editor—Clayton Hoagland, 90 William Street, New York City. Business Manager—Alfred P. Howes, 90 William Street, New York City.

2. That the owner is: Howes Publishing Company, Inc., 90 William Street, New York City: Louis A. Olney, Lowell, Mass.; Alfred P. Howes, 90 William Street, New York City; Mary K. Howes, Northampton, Mass.; William F. Collins, Upper Montclair, N. J.; Derfla H. Collins, Upper Montclair, N. J.; N. H. Hiller, Carbondale, Pa.; Joseph L. Schroeder, Hartsdale, N. Y.

3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest, direct or indirect, in the said stock, bonds or other securities than as so stated by him.

Alfred P. Howes, Publisher.

Sworn to and subscribed before me this 30th day of September, 1924.

[Seal.] Edwin Safford.

(My commission expires March 30, 1925.)

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TEXTILE CHEMIST

Textile chemist with broad scientific and executive experience desires position installing and maintaining scientific control of materials and processes in a textile mill. Address Box 275, American Dyestuff Reporter.

DYE CHEMIST

WANTED—Young man familiar with dyestuffs for testing laboratory of manufacturing concern. State salary desired, experience and references. Address Box 276, American Dyestuff Reporter.

THE Annual Meeting of the American Association of Textile Chemists and Colorists will be held in Philadelphia, with headquarters at the Bellevue Stratford Hotel, on Saturday, Dec. 6th, 1924

A number of unusually good papers will be presented during the Saturday morning and afternoon sessions and there will be several speakers of national reputation at the banquet in the evening.

A pleasant surprise will be in store for those who can arrange to arrive in time for the "Get-Together Smoker" on Friday evening, December 5th, which will also be held in the Bellevue Stratford Hotel.

Those in attendance will feel amply repaid. Philadelphia is a textile centre of unusual interest and importance. A few prominent local manufacturers have consented to show samples of particular merit. Don't miss this chance of seeing something of Philadelphia's great Textile Industry.

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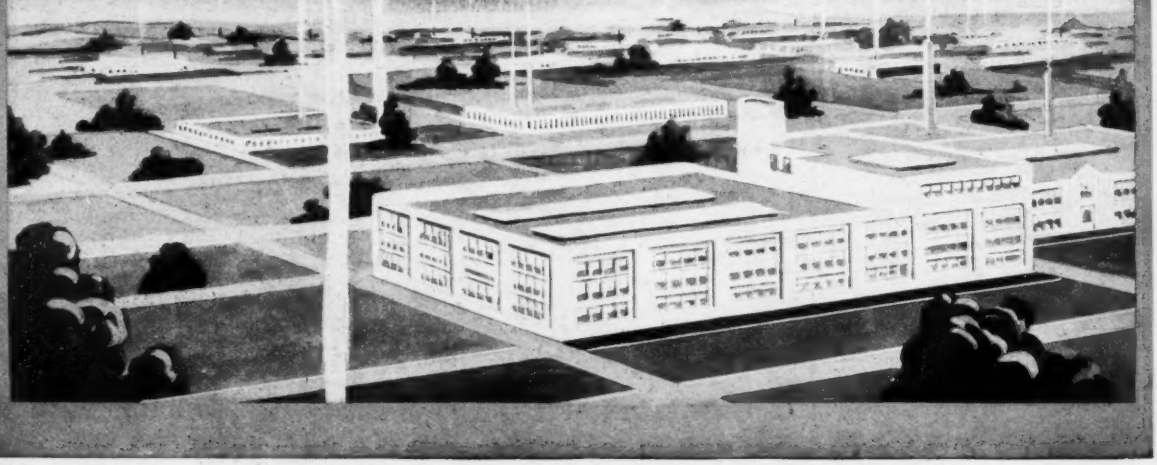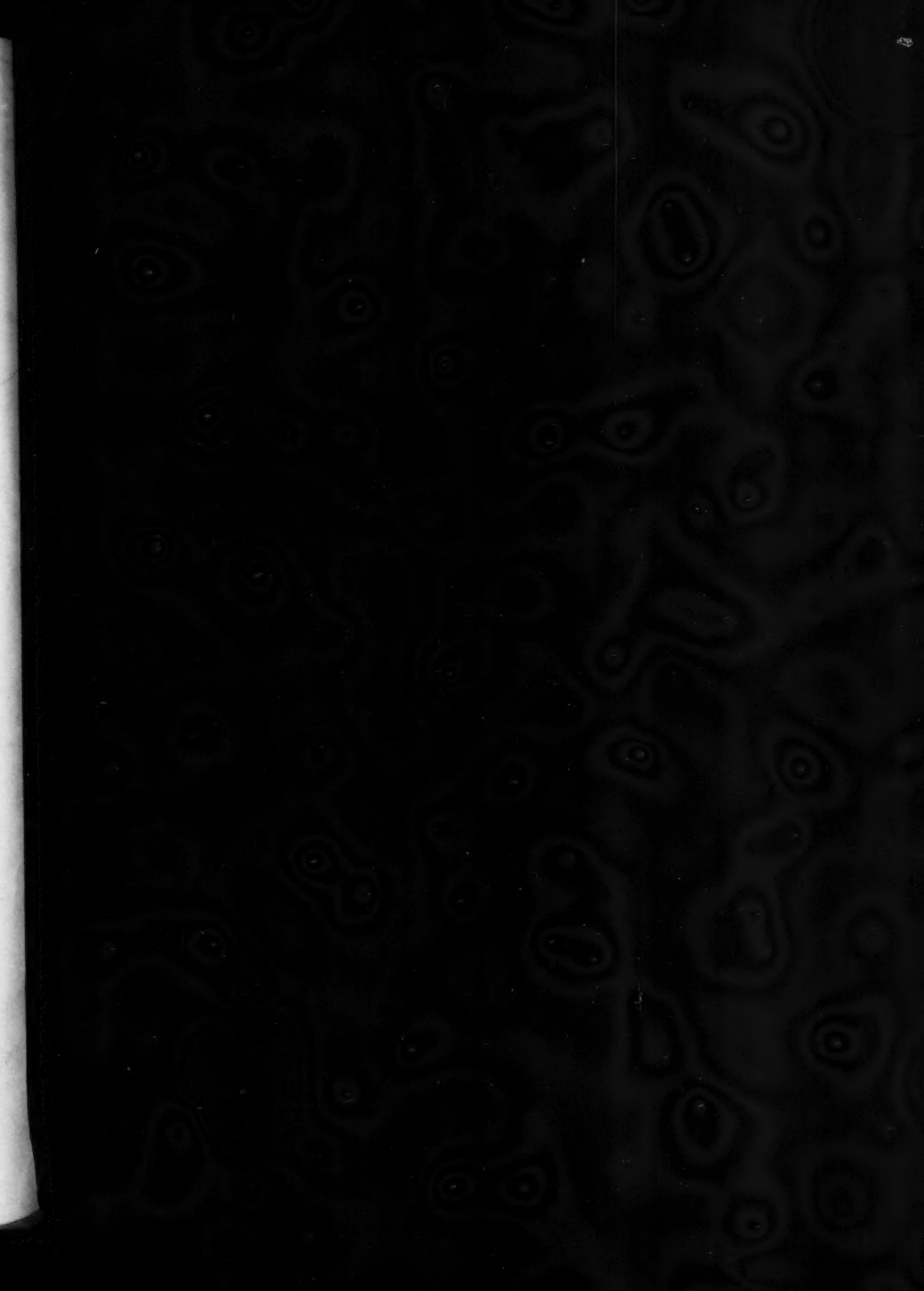
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